ctc technology & energy

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Centre County Broadband Strategic Plan

Centre County

Planning and Community Development Office

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1 Executive summary

In November 2021, the Centre County Planning and Community Development Office commissioned a countywide broadband study to examine existing infrastructure, refine the identification of unserved areas, investigate the extent of underserved locations, and develop a strategy for filling those gaps. With foresight, Centre County leaders conducted this study in anticipation of newly enacted federal laws providing funding for broadband infrastructure in response to the Covid-19 pandemic.

Centre County has prioritized taking a countywide approach to closing broadband gaps. Several other Pennsylvania counties are working to close their gaps in broadband availability, reliability, and speeds in both urban and rural areas. Like most of these counties, Centre County has determined that a public-private partnership that incentivizes private internet service providers (ISP) to fill those gaps best reflects its priorities and risk appetite.

The County has also adopted the current federal standards for broadband deployment that emphasize future-proof solutions. These standards, which will be reflected in upcoming State-administered funding opportunities, 1) prefer fiber over other technologies and 2) adopt a preference for targeting unserved areas with speeds lower than 25 Mbps download, 3 Mbps upload (25/3), but 3) also target underserved areas with available speeds above 25/3 but less than 100/20 as a secondary priority.[1]

The goal of this report is to position the County for newly created broadband infrastructure funding programs geared toward addressing gaps in broadband connectivity. The County government is in the best position to spearhead efforts to secure available funds to help private partners fill those broadband gaps.

The methodology used in this report includes:

- Identifying government and community stakeholders, and existing broadband providers in the County
- Developing an understanding of the gaps in broadband infrastructure and service across the County through data analysis, desk and speed surveys, and analysis of areas that were awarded in the Federal Communications Commission's (FCC) Rural Digital Opportunity Fund (RDOF) auction
- Engaging with incumbent ISPs to define coverage areas

[1] National Telecommunications and Information Administration, "Notice of Funding Opportunity: Broadband Equity, Access, And Deployment Program," https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf (accessed August 29, 2022).

- Convening County stakeholders to identify challenges and gaps in broadband access
- Developing two candidate designs and associated cost estimates for a fiber-to-the-premises (FTTP) network to reach 1) unserved areas, and 2) both unserved and underserved areas
- Creating programmatic, actionable recommendations for filling broadband gaps and analyzing the potential for new federal funding sources to pay for solutions

This study identified the following key findings.

1.1 Approximately 7,900 of Centre County's addresses are unserved or underserved by wireline broadband

A detailed and comprehensive study of broadband infrastructure in Centre County has identified approximately 4,300 addresses in large, contiguous areas that are unserved, with reliable speeds below 25/3 Mbps.

Up to an additional 3,600 addresses are considered underserved as they experience service with speeds above 25/3 but below 100/20 Mbps. Many of these locations are served by existing cable infrastructure in Centre County that appears outdated and over-burdened, based on reported complaints and speed survey results.

In total, approximately 7,900 address locations are unserved or underserved by wireline broadband (see Figure 1).

Figure 1: Map of unserved and underserved areas in Centre County

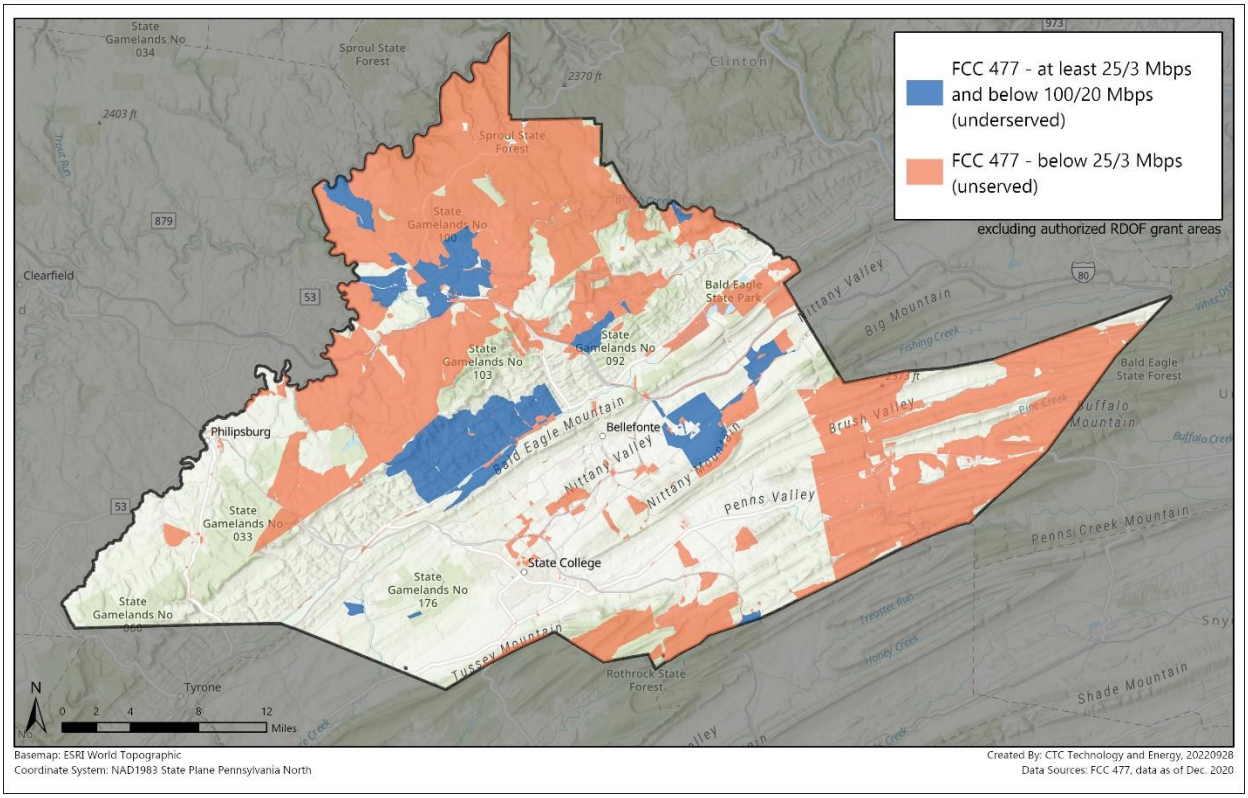
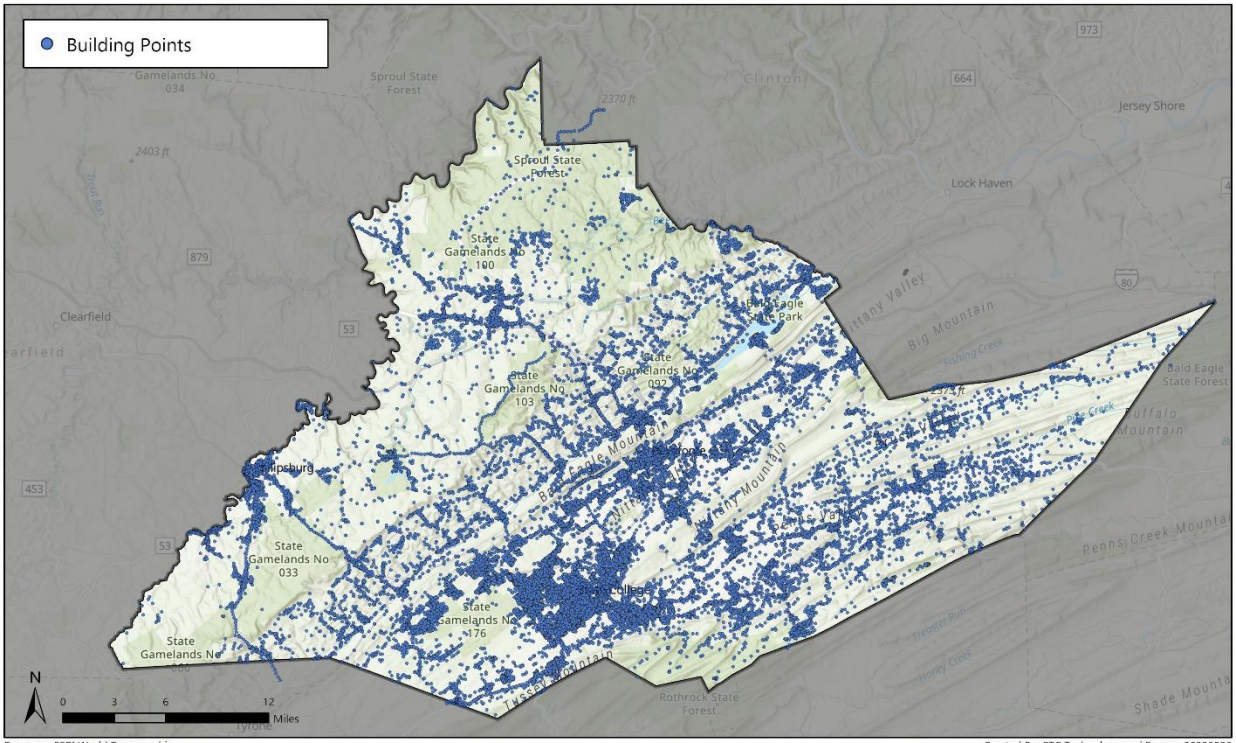


Figure 2 shows the distribution of the County's address locations. These derive from dispatchable housing structures (usually where there is a phone line). They roughly correspond to broadband serviceable locations, defined by the FCC as a "business or residential location … at which fixed broadband internet access service is, or can be, installed."[2] As the map illustrates, large, sparsely populated rural areas in the northern part of the County could require substantial infrastructure investment, resulting in a higher per-passing cost to serve. While federal funding has a strong preference for future-proof technology, extremely high-cost funding requests may be determined by the State as too expensive to deploy with fiber. In this scenario, the State may then make deployment of alternate, less robust technologies (fixed wireless, licensed/unlicensed spectrum) available so long as they meet minimum speed requirements.[3]

[2] National Association of Counties, "Broadband Serviceable Location Production Fabric Now Available to Counties," https://www.naco.org/blog/broadband-serviceable-location-production-fabric-now-available-counties# (accessed September 30, 2022).

[3] Broadband Equity, Access, and Deployment Program Notice of Funding Opportunity, May 13, 2022, https://broadbandusa.ntia.doc.gov/resources/grant-programs/broadband-equity-access-and-deployment-bead-program (accessed October 3, 2022).

Figure 2: Distribution of building locations

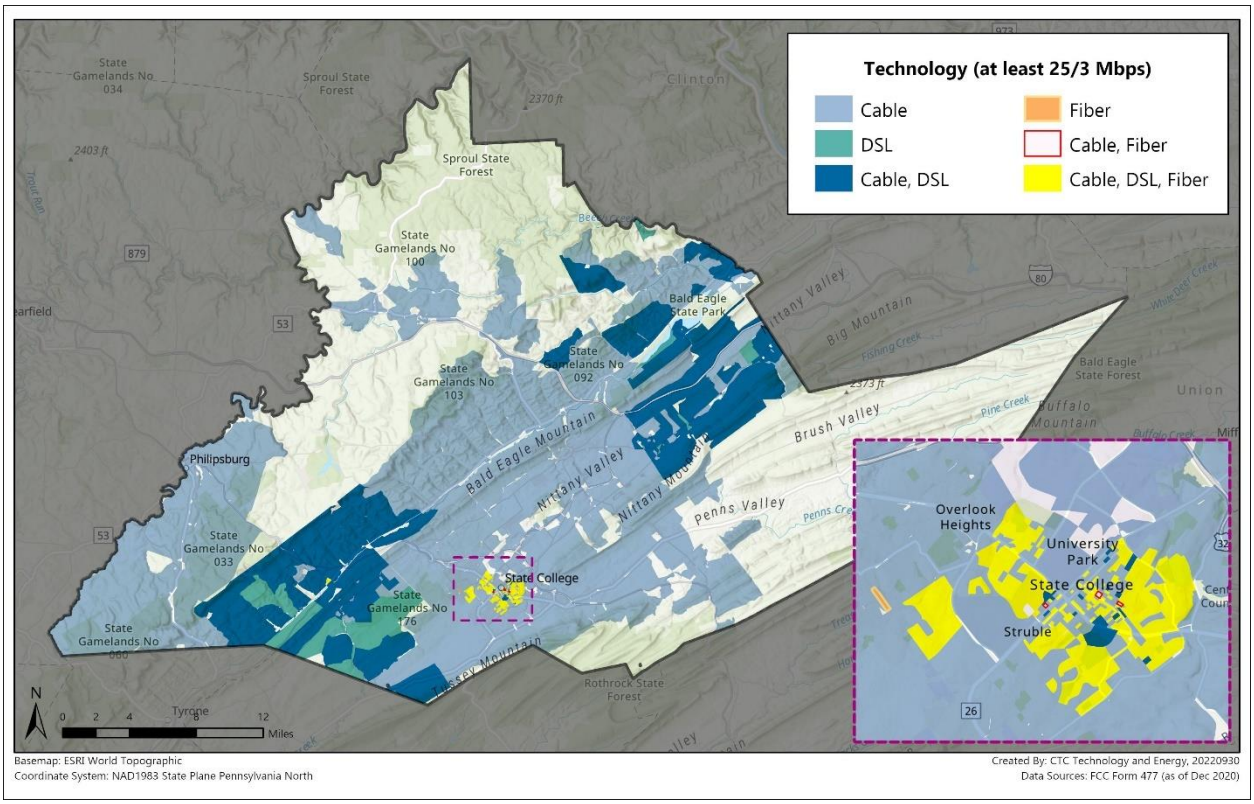


1.2 Improvements to the cable infrastructure in the County are needed

Coaxial cable technology is used throughout the County to provide internet connectivity. However, a substantial number of locations in Centre County are currently served by wireline cable that does not reliably provide speeds at or above 100/20, the current standard below which locations are considered underserved—and are potentially eligible for federal funding.

A combination speed test and survey conducted by CTC (detailed in Section 2.4) confirmed anecdotal reports from residents of low speeds and dropped connections prevalent in coaxial cable service from one of the providers within Centre County—Zito Media. The County cited persistent resident complaints of reliability issues. Unfortunately, there is no way to document these bottlenecks through visual inspection in the field, and a systematic assessment would require detailed knowledge of the physical network architecture. Documenting these performance issues for the sake of potential future funding would therefore require close cooperation with the ISP or detailed, ongoing speed testing and surveys.

Figure 3: Wireline communication technologies deployed in Centre County



1.3 Fixed wireless in Centre County will not meet current speed and reliability standards

The varied physical geography and far-flung locations in some unserved rural areas within Centre County make the deployment of a fiber infrastructure to all areas of the County cost prohibitive. A fixed wireless strategy could provide a viable solution for the most sparsely populated areas. However, in areas currently covered by fixed wireless, most networks have not been able to deliver 25/3 speeds consistently—let alone 100/20—and would require significant upgrades (and installation of fiber backhaul where possible) to deliver those speeds.

Current federal funding—and future State funding—requires the use of fiber or other future-proof technology for all but the most extremely high-cost locations. In addition, upcoming funding from the Broadband Equity, Access, and Deployment (BEAD) program that will flow through the State broadband office requires more robust and future-proof solutions be given preference rather than jumping straight to cheaper fixed wireless only deployments—for example, a hybrid fiber and fixed wireless design that strategically uses wireless technology for the most expensive segments only. Solutions relying only on fixed wireless could be required to

use costlier licensed spectrum rather than the unlicensed spectrum typically used in rural areas where there are fewer customers and less interference.

1.4 Closing broadband coverage gaps will involve fiber deployment in addition to upgrades to cable infrastructure

Based on preliminary mapping and extensive stakeholder interviews, the cost of a fiber-to-the-premises (FTTP) network to extend wireline connectivity to the County's unserved addresses is estimated to be approximately $121.4 million, including a 15 percent contingency cost on construction materials. Connecting all unserved and underserved addresses is estimated to cost $149.1, with the same contingency. Both estimates assume a mix of 73 percent aerial construction (the preferred method of construction by current wireline providers in the County) and 27 percent underground construction, as well as a 60 percent take-rate—i.e., 60 percent of locations subscribe to service.

This is a conservative estimate. Incumbent providers that have access to utility poles and can cost-effectively extend infrastructure from their existing networks are likely to be able to drive costs down below this estimate. The mapping completed with this study will allow a competitive solicitation process that—aided by grant funding—could significantly drive down the County government's costs. Likewise, upgrades to existing cable infrastructure to meet the speed thresholds required by federal funding guidelines could reduce costs further.

1.5 There is a strong appetite for public-private partnerships among incumbent ISPs

Engagement with incumbent ISPs in Centre County indicates a strong willingness to partner with the County on grant applications to address unserved locations. A few ISPs, such as Centre WISP, indicated interest in a variety of areas in the County, while others expressed interest in edging out of their current infrastructure—i.e., expanding the boundaries of their existing coverage outward from the current edges of the network. Section the results of interviews conducted with ISPs.

1.6 Recommendations

Based on the data and analysis summarized above, this report makes the following recommendations.

1.6.1 Take a countywide approach in anticipation of BEAD and other federal funding opportunities

Federal funding from the American Rescue Plan Act (ARPA)—including the Coronavirus Capital Projects Fund and Coronavirus State and Local Fiscal Recovery Funds (SLFRF)—is currently flowing to states. The subsequent bipartisan Infrastructure Investment and Jobs Act (IIJA) provides an unprecedented funding opportunity for broadband deployment. Funding from the

BEAD program will be administered by the State of Pennsylvania. This unique funding opportunity means that the County can take a holistic approach to reaching unserved addresses. Previously, broadband infrastructure deployments were often limited to projects with economies of scale to attract investment by high-quality wireline (cable or fiber) providers, which typically excluded rural areas with low population density. However, the sudden influx of capital from federal funding could support larger projects encompassing outlying areas that would have been excluded in years prior.

1.6.2 Consider issuing a request for proposal (RFP)

The most expedient path to addressing unserved locations may be for the County to issue a request for proposal (RFP) to ISPs. The County can use ARPA or other funds to create an immediate grant opportunity if it chooses. This process has the potential to serve a dual purpose by 1) resulting in faster deployment of specific broadband projects, and 2) acting as a mechanism to identify projects and gauge interest for future projects eligible for State grant funding made possible through various IIJA programs (described in Section 4).

1.6.3 Set aside funds to match private partner investments, if feasible

While local governments will need to wait for rules to be drafted by the State before applying for funding through the BEAD program, the County should set aside funds for matches now and consider other ways it can incentivize participation from ISPs to maximize the competitiveness of its grant applications. This match pool can be leveraged for the BEAD opportunity, for a smaller upcoming federal grant, and/or for a County-released grant project. The BEAD notice of funding opportunity makes it clear that States will prioritize applications with higher match amounts.[4] CTC recommends consideration of a multi-award process to reach the maximum number of unserved locations and creatively tackle challenging addresses.

1.6.4 Maintain a strong line of communication with the State Broadband Development Authority

To ensure that project applications are structured favorably, the County should remain actively engaged with the Pennsylvania Broadband Development Authority's progress on its development of BEAD funding rules. The Authority, an independent agency of the Department of Community and Economic Development (DCED)[5] are currently building a framework for the State's broadband plan. This framework will establish grant funding guidelines for forthcoming BEAD funding and is required by law to involve intensive stakeholder outreach. In addition to

[4] NTIA Notice of Funding Opportunity, Broadband Equity, Access, and Deployment Program, Section III.B, https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf (accessed September 27, 2022).

[5] Pennsylvania Department of Community and Economic Development, Pennsylvania Broadband Development Authority – Expanding Broadband Services Across Pennsylvania, https://dced.pa.gov/broadband-resources/pennsylvania-broadband-development-authority/ (accessed September 30, 2022).

relaying the County's broadband planning efforts, keeping the Authority informed about proposed projects will ensure that the State consider a wide range of projects and models for developing public-private partnerships.

2. The current state of broadband in Centre County

To better understand Centre County's needs, the project team conducted a multi-phased assessment of broadband availability and engaged with stakeholders to identify broadband-related challenges and opportunities. The assessment included:

- Aggregating publicly available data combined with infrastructure data provided by the County in response to an information request to develop initial mapping
- Identifying the unserved and underserved addresses in the County
- Deploying a 10-week online speed survey to help identify areas of interest, refine 477 data maps, and assist in identifying reliability and coverage issues within areas formerly designated as served
- Conducting a Community Infrastructure Assessment to identify incumbent providers and organizations with an interest in establishing a footprint within the County; research was conducted to assess service areas for each provider and the technology employed, determine available connection speeds, and investigate the cost of various internet plans available to residents
- Engaging strategic stakeholders, anchor institutions, and residents
- Meeting with incumbent and potential ISPs to verify service areas, ascertain future plans for expansion, and gauge the private sector's appetite for partnering with the County on future grant opportunities

The findings from this study are described in the sections below. Due to the limitations of sharing data with the County,[6] maps in this report represent approximated and anonymized boundaries to protect proprietary data shared with CTC for purposes of analysis.

2.1 Centre County has an estimated 4,300 unserved locations concentrated in rural areas and geographically isolated clusters

As in many counties with rural areas, most unserved households in Centre County are in identifiable, contiguous, sparsely populated areas. Cable providers largely built their networks to provide television services in urban areas and built to the entire community under a

[6] On February 14, 2008, the Pennsylvania Senate passed the Right-To-Know Law, which established that all state and local records are presumed to be public. CTC utilized proprietary data to calculate high-level network design estimates. Maps represented herein are based on publicly available FCC 477 data, E-911 data, feedback from county residents, and speed survey results and abstract, conducted for the purpose of this study. No proprietary data was shared with the Planning and Community Development Office. "About the Right-To-Know Law," Pennsylvania Office of Open Records, March 3, 2022, https://www.openrecords.pa.gov/RTKL/About.cfm (accessed September 20, 2022).

franchise agreement framework in exchange for access to the public right of way. While these cable providers have extended their networks in suburban areas where there is sufficient density, they have not built infrastructure in rural locations either because the low density of households does not create the economies of scale required to undertake the project, or because the logistical challenges of building to the location make construction cost prohibitive. Fiber optic service is spotty and typically concentrated in the more affluent and business neighborhoods of urban and suburban areas, but telecoms and cable providers have increasingly moved to fiber for expansions and upgrades.

The unserved populations are largely concentrated in the northern, midwestern, and eastern parts of the County, with scattered clusters along geographically isolated areas in the central and southern parts of the County. Unserved areas include:

- Most of the northern part of the County north of Route 80
- The area from Beaver Road stretching to the western boundary and south to Sandy Ridge
- Geographically isolated northern areas flanking the Nittany Valley to the northeast edge of the County
- The northeast corner of the County along the Union County border
- Areas south of Penns Valley along the Mifflin County border

2.2 An estimated 3,600 underserved addresses largely consist of locations served by cable providers facing aging infrastructure and geographic challenges

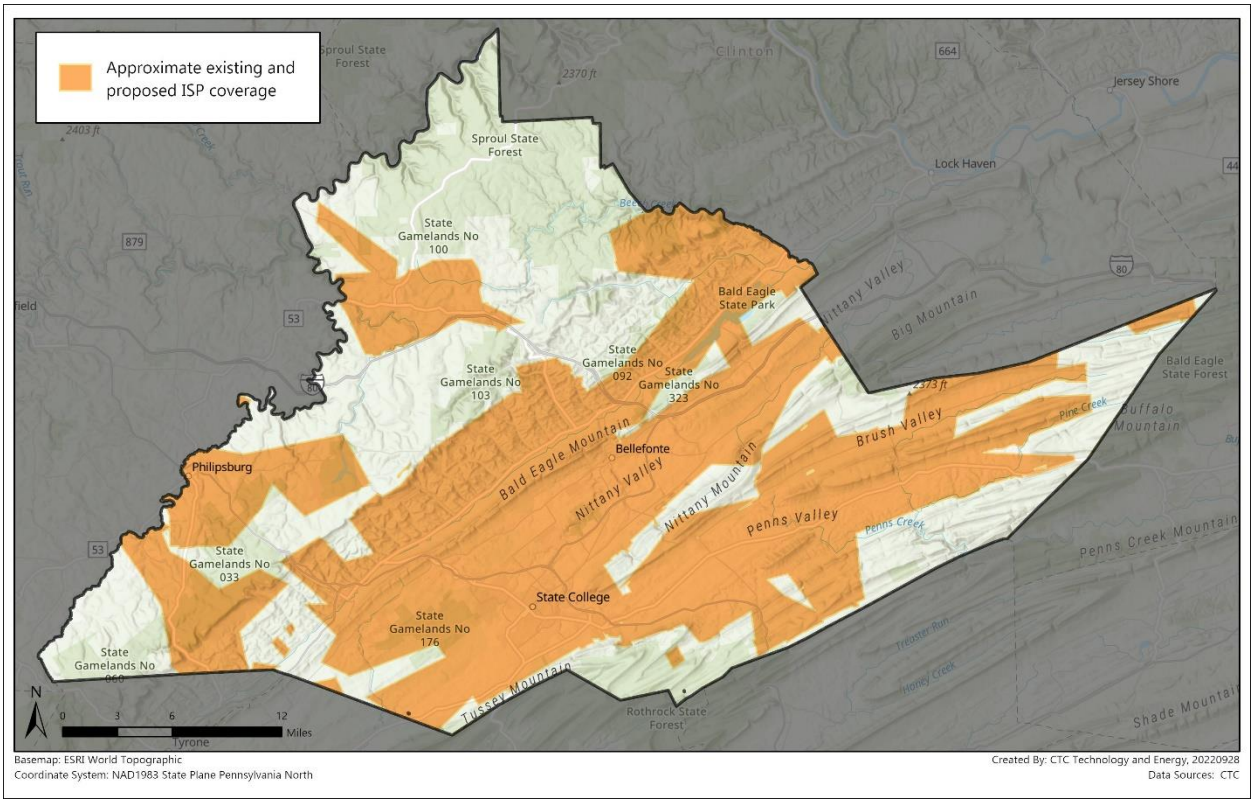
In addition to unserved addresses, Centre County has concentrations of areas that are designated as underserved with routine speeds greater than 25/3 Mbps, but lower than 100/20 Mbps. Underserved areas in Centre County include:

- The town of Clarence reaching west along Elm Road/Kylertown Drifting Highway and Pine Glen Road/Route 879
- The west side of Bald Eagle Mountain from Walker Hollow Road south to Yeager Hollow Road
- An area between Appalachian Highway and Nittany Valley Road from Snydertown to Axemann
- Spring Creek Canyon
- Pockets surrounding Penn State University's University Park campus

2.3 Projects are planned to expand broadband coverage

Informed by interviews with ISPs and publicly available data, CTC has mapped an approximate coverage area currently claimed as being served by broadband. Several funded projects will expand this approximate coverage area, as shown in Figure 4. The map includes coverage by existing providers, multiple projects that have received State and County funding to deliver high-speed internet to four townships and the Snow Shoe area, and RDOF-awarded areas (as detailed in Section 2.3.5).

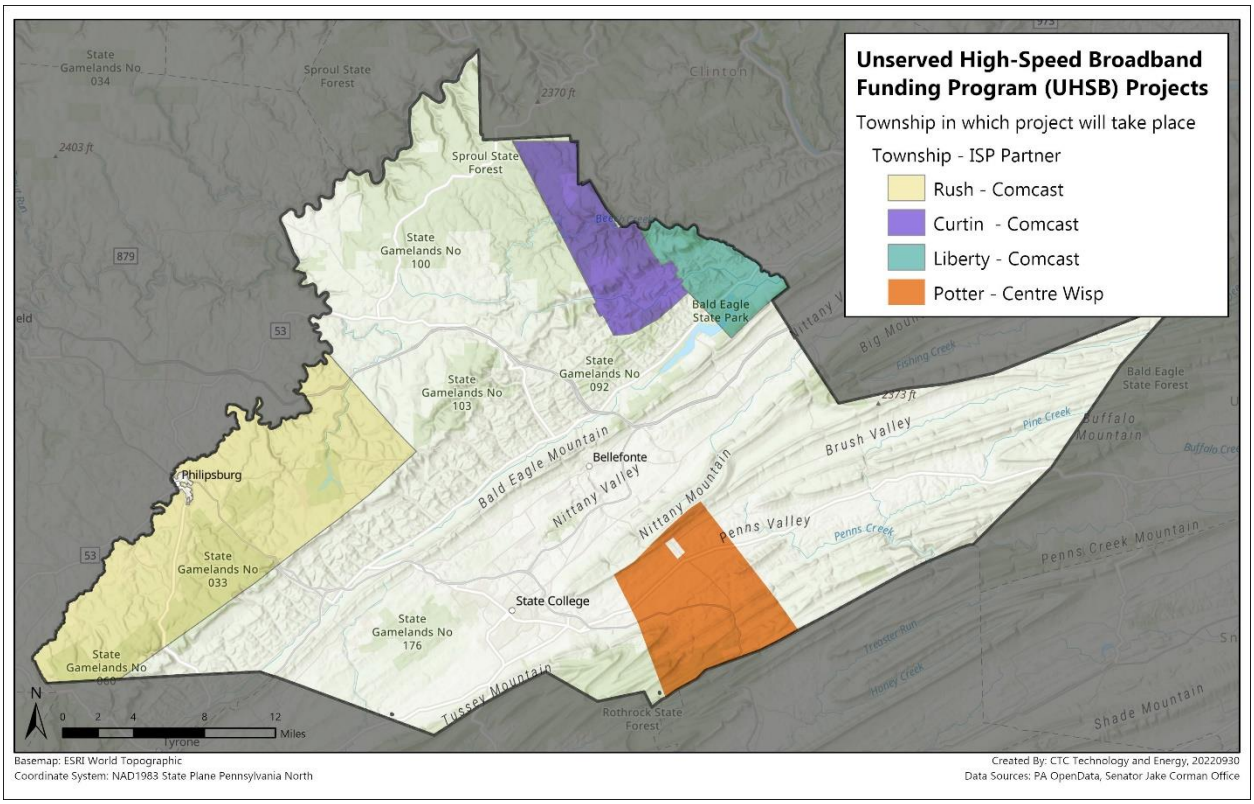
Figure 4: Estimated broadband coverage including approved project areas in Centre County



Projects recently awarded State and County funding to deploy reliable, wireline connectivity to select townships are illustrated in Figure 5. The Unserved High-Speed Broadband Funding Program [7] (UHSB)—administered by the Pennsylvania Department of Community and Educational Development (DCED)—targets unserved locations through grants to construct middle- and last-mile high-speed broadband infrastructure. In 2022, the UHSB awarded $10 million in funding for 19 projects throughout the state. Three of the projects (targeting four communities) are located in Centre County.

[7] Pennsylvania DCED, "Unserved High-Speed Broadband Funding Program (UHSB)," https://dced.pa.gov/programs/unserved-high-speed-broadband-funding-program-uhsb/ (accessed September 26, 2022).

Figure 5: Townships where UHSB projects are located



Lastly, a statewide initiative being considered by Pennsylvania's higher education anchor institutions has the potential to provide middle-mile infrastructure resources for Centre County.

2.3.1 Potter Township[8]

In March, Centre WISP Venture Company LLC was awarded $975,109 through a UHSB grant to deploy a wired network in Potter Township. The expansion of the ISP's existing network involves installing 21.6 miles of fiber optic cable to deliver speeds of at least 250/1G to 277 unserved residential addresses and 14 businesses.[9]

2.3.2 Curtin and Liberty Townships

Comcast Cable Communications, LLC was also awarded $578,235 in UHSB grants to construct wired infrastructure in the Curtin and Liberty Townships. The project will extend Comcast's

[8] In November 2021, the Patton Township Board of Supervisors authorized a study to "[explore] outcomes, possibilities, and paths for the purpose of identifying optimal goals and approaches for Patton Township to use in advancing broadband access for its residents."

[9] "Centre County gets $2.3 million to expand high-speed broadband. Here are the 3 projects," *Centre Daily Times*, https://www.centredaily.com/news/local/article259658580.html (accessed September 29, 2022).

existing cable infrastructure to connect 160 households and 17 businesses currently receiving speeds below the 25/3 Mbps threshold.

2.3.3 Rush Township

A third UHSB awarded project in Centre County will extend Comcast's cable network to deliver wireline broadband to as many as 147 potential connections in Rush Township. The $750,000 award will fund wireline infrastructure targeting unserved addresses.[10]

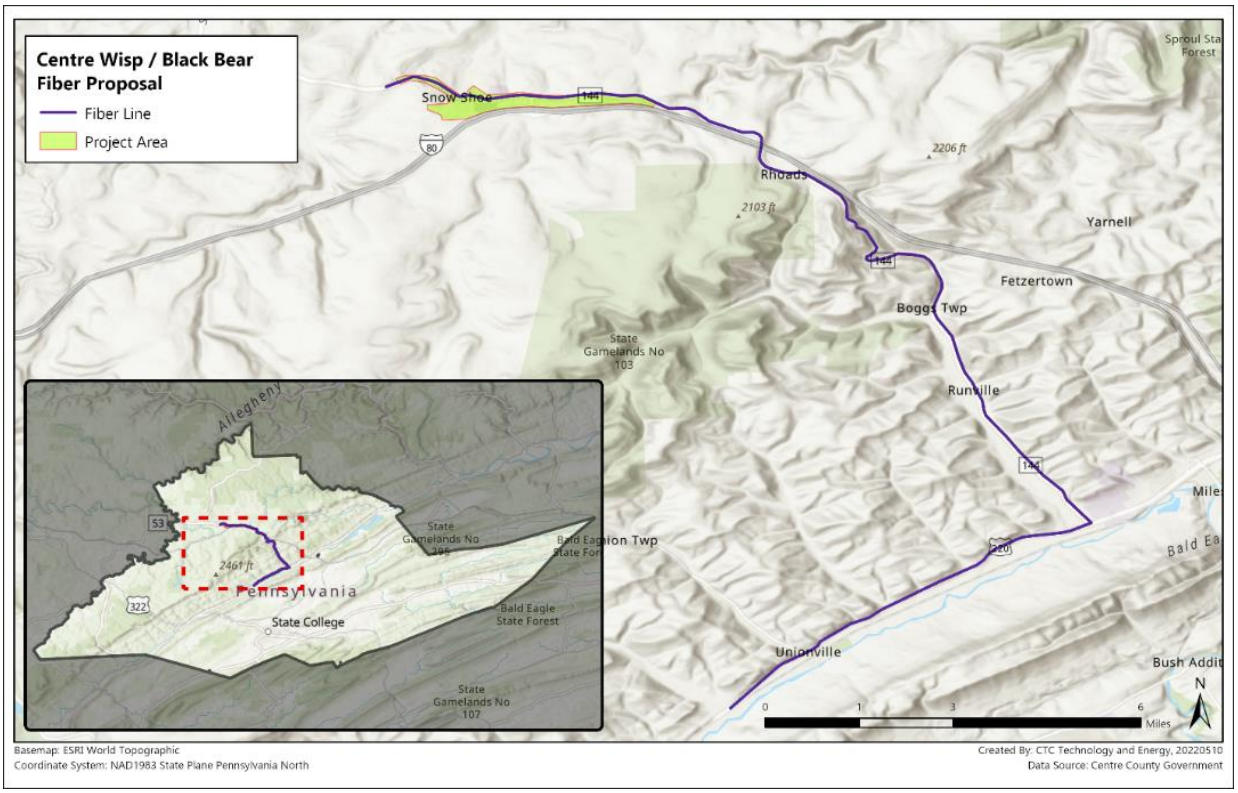
2.3.4 Snow Shoe broadband project

In coordination with the Susquehanna Economic Development Administration-Council of Governments (SEDA-COG), Centre County issued an RFP for Rural Broadband Deployment[11] on November 22, 2021, allowing for up to $210,000 in reimbursable grant funding. Eligible expenses under the grant include equipment, lease payments, lease of land or vertical assets, and engineering costs. Black Bear Fiber, the fiber deployment subsidiary of Centre WISP, will deploy wireline connectivity to 220 households with speeds of 250 Mbps or 1 Gbps symmetrical. Black Bear Fiber indicated in its RFP response that it anticipates an additional 628 addresses outside of the target area to be served through this construction project, totaling 848 unserved locations.[12] The provider will utilize dark fiber leased from the Keystone Initiative for Network Based Education and Research (KINBER), a network connecting educational institutions that was recently acquired by the middle-mile carrier FirstLight, for the project.

[11] Susquehanna Economic Development Administration-Council of Governments, "Request for Proposals for Rural Broadband Development," https://seda-cog.org/wp-content/uploads/RFP-Centre-County-Rural-Broadband-Deployment-final.pdf (accessed September 26, 2022).

[12] Since there is no legal commitment to service additional addresses outside of the service area, cost estimates contained in this report include these (currently) unserved locations.

Figure 6: Map of Black Bear Fiber's Snow Shoe fiber deployment project



2.3.5 The Rural Digital Opportunity Fund auction

The results of the FCC's Rural Digital Opportunity Fund (RDOF) auction in 2020 will support the expansion of broadband service in a portion of the County. The auction awarded subsidies to bidders that committed to building new broadband infrastructure and delivering service in currently unserved areas nationwide. The auction format was designed to select the best technologies available, offering a higher share of federal subsidies to bidders that promised to deliver higher-speed services.

The FCC relied on inaccurate coverage maps to identify areas eligible for the auction, so some unserved areas in Centre County were not deemed eligible for the auction.[13] Even so, the winning bidders in the County were awarded subsidies to build an all-fiber network that will serve approximately 2,819 addresses. These locations were excluded from the unserved areas identified in this report.

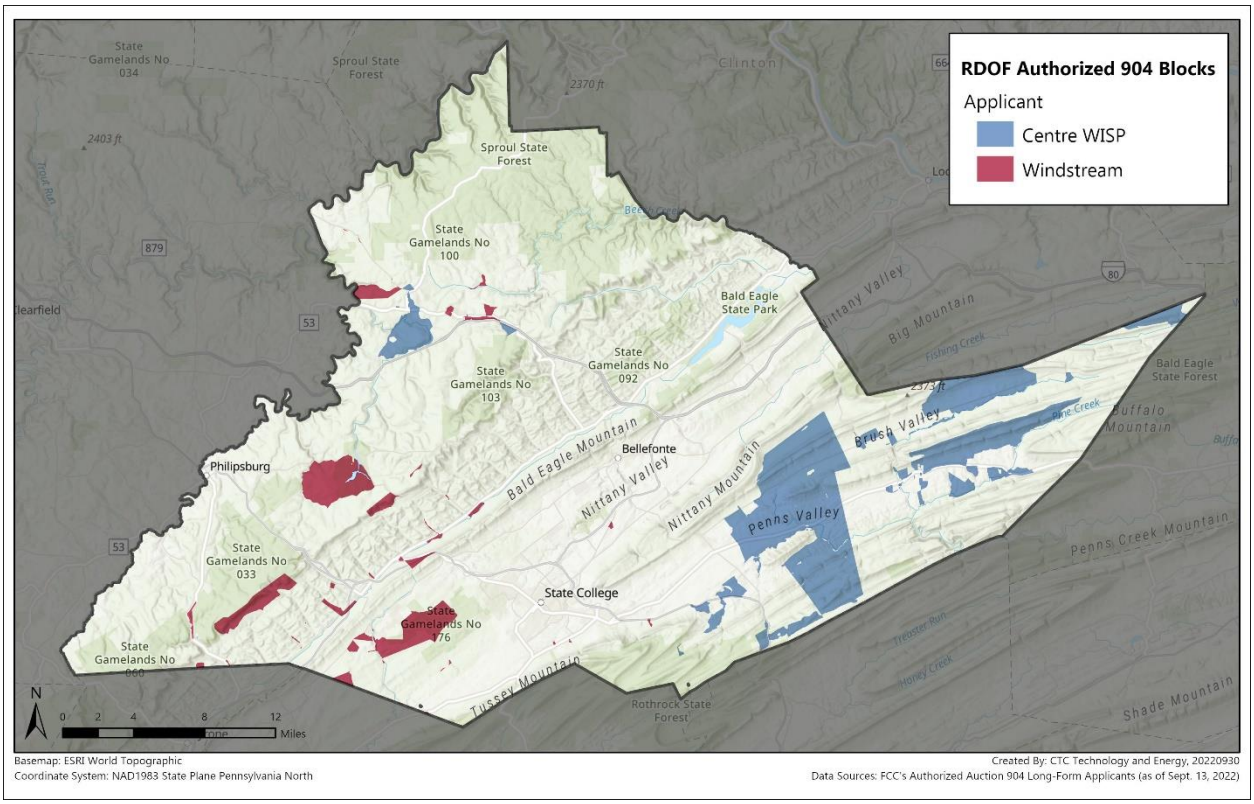
[13] FCC, "Auction 904: Rural Digital Opportunity Fund," https://www.fcc.gov/auction/904 (accessed February 25, 2022).

Two providers received funding for County projects through the RDOF auction: Centre WISP Venture Company LLC and Windstream Services LLC. Table 1 shows RDOF funding amounts and locations served in Centre County.[14]

Table 1: RDOF awarded projects[15]

Provider	Funding amount	Locations
Centre WISP Venture Company, LLC	$1,108,634.84	6,607 2,465 In Centre County
Windstream Services LLC, Debtor-In-Possession	$14,874,618.07	53,846 354 in Centre County

Figure 7: RDOF auction results in Centre County



[14] "Rural Digital Opportunity Fund Phase I,"FCC Public Reporting System, https://auctiondata.fcc.gov/public/projects/auction904/reports/winning_bidders (accessed September 30, 2022).
[15] Data aggregated from FCC.gov. "Auction 904: Rural Digital Opportunity Fund," FCC, https://www.fcc.gov/auction/904/round-results (accessed October 3, 2022).

2.3.6 Pennsylvania State University middle-mile project

A 2019 statewide study funded by the Center for Rural Pennsylvania examined internet availability and access across the State. Spurred by the lack of internet access and performance transparency, including the disparity between reported and actual speeds, [16] the telecommunications department of the Pennsylvania State University (Penn State) is leading a broad consortium of higher education institutions across the state to develop an open access, middle-mile fiber loop utilizing indefeasible rights of use (IRU) and existing networks. The goal of the initiative is to construct a cost-effective statewide open-access middle-mile infrastructure to reduce the last mile burden.

Though still in the planning stages and highly timing-dependent, the project could provide access points for buildout and has the potential to speed up deployment, especially for smaller providers who currently lack the scale necessary to deploy quickly. The County should continue its open relationship with the university to track the progress of this project.

2.4 Speed survey data confirm low speeds in areas designated as underserved and served—particularly those served by cable

According to County officials, coaxial cable service residents report low speeds and dropped connections. To assist in visualizing anecdotal feedback and to identify the efficacy and location of various technologies, the project team designed and deployed an internet speed survey. The purpose of the survey was to measure upload and download speeds experienced by County residents, assist in defining ISP coverage areas, and gauge the quality of connectivity.

Due to the promotional efforts of the Planning and Community Development Office and Centre County's highly engaged population, the speed survey was well-received and resulted in a high response rate from County residents. Through data collected over an eight-week period, CTC was able to confirm unserved locations and identify gaps in coverage in areas currently designated as served.

2.4.1 Speed survey performance correlates with provider technology

Overall, 1,517 speed surveys were independently submitted throughout the County (see Figure 8). Of these locations, 34 percent of tests reported automatically computed speeds below the threshold designated as unserved (25/3 Mbps) and a further 58 percent reported speeds higher than 25/3 Mbps but lower than the 100/20 Mbps threshold; these locations are considered underserved by the standards of forthcoming funding opportunities. Survey respondents also

[16] The Center for Rural Pennsylvania, "Broadband Availability and Access in Rural Pennsylvania," rural.pa.gov/download.cfm?file=Resources/PDFs/broadband/Broadband_Availability_and_Access_in_Rural_Pennsylvania_2019_Report.pdf (accessed September 27, 2022).

reported 54 addresses where no reliable broadband service was available at any speeds (see Figure 9).

Figure 8: Mapped speed test survey results by speed

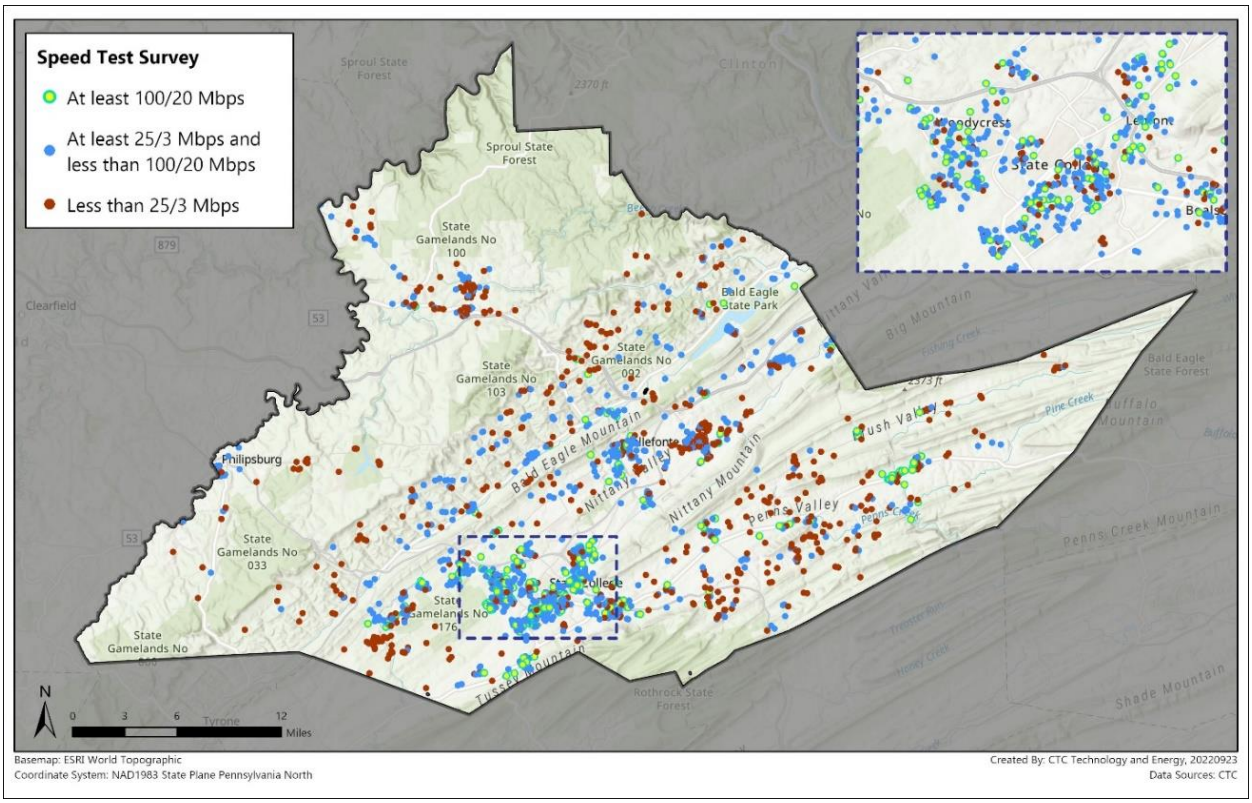
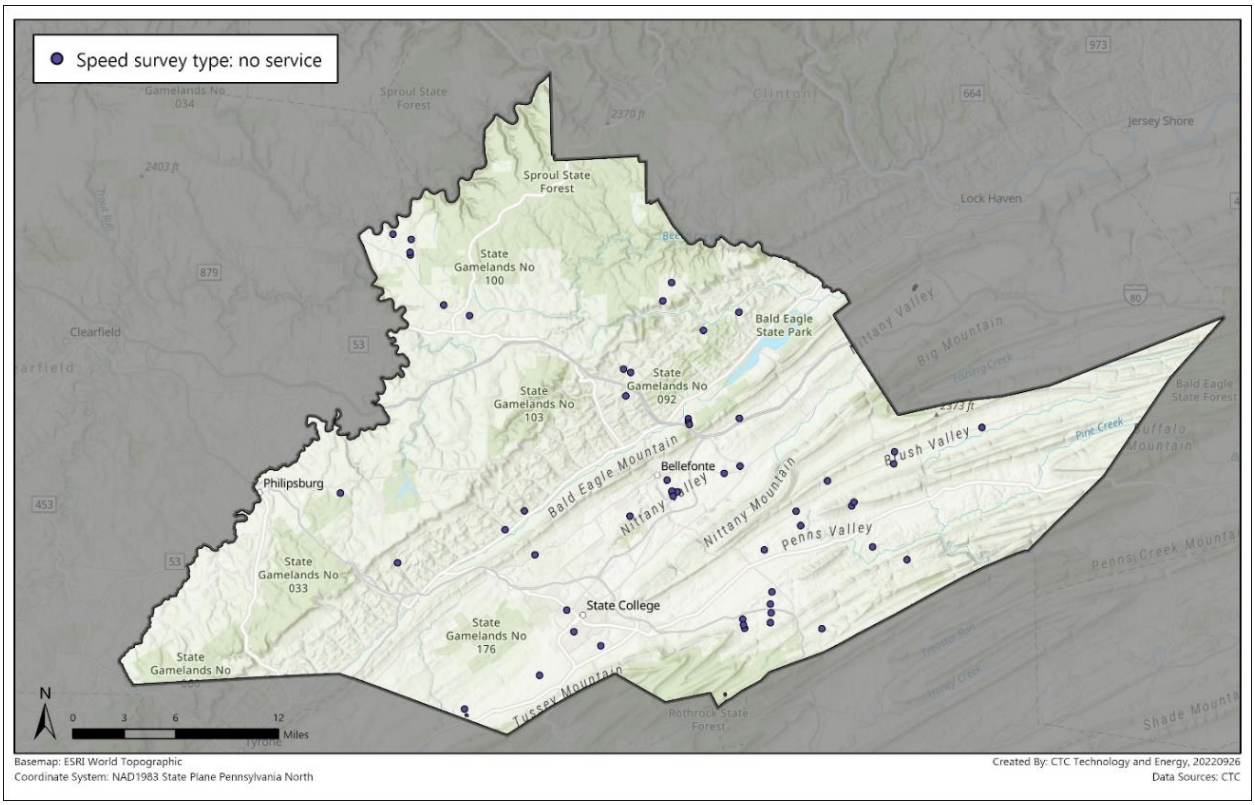
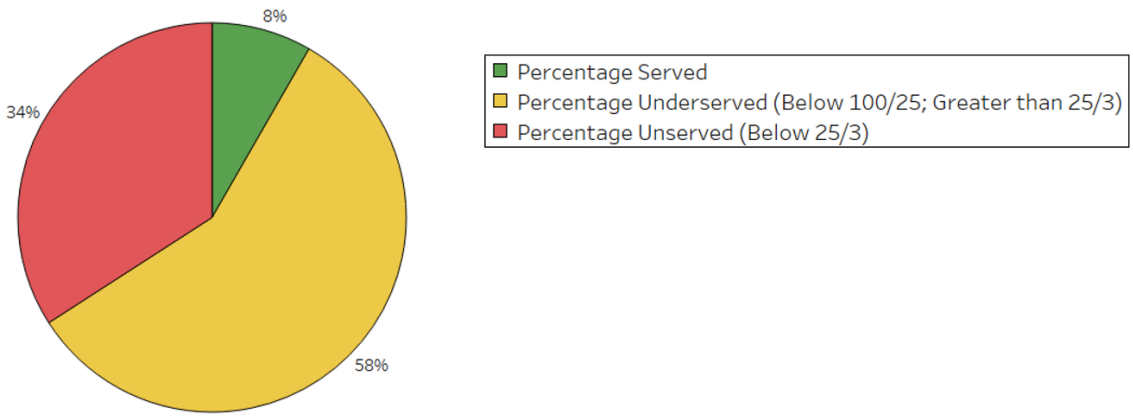


Figure 9: Map of locations reported as having no internet service available at any speed



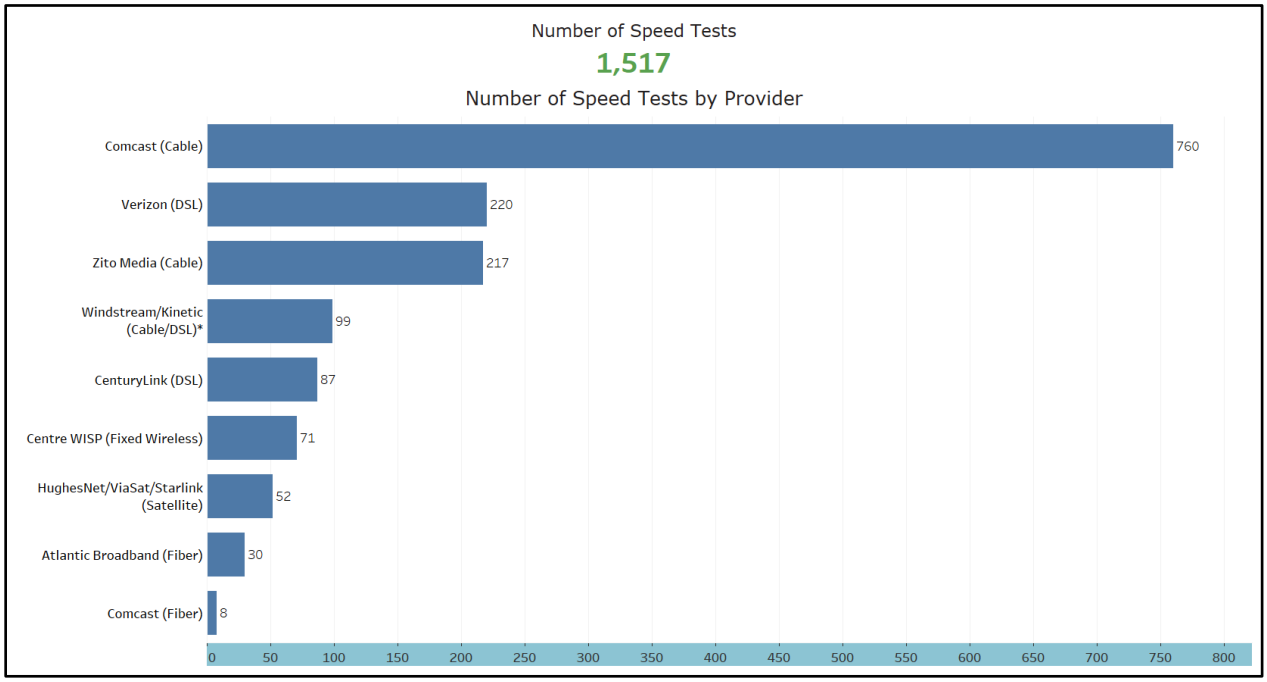
All told, 92 percent of speed survey responses reported speeds designated as unserved or underserved, as shown in Figure 10.

Figure 10: Connectivity status of survey respondents



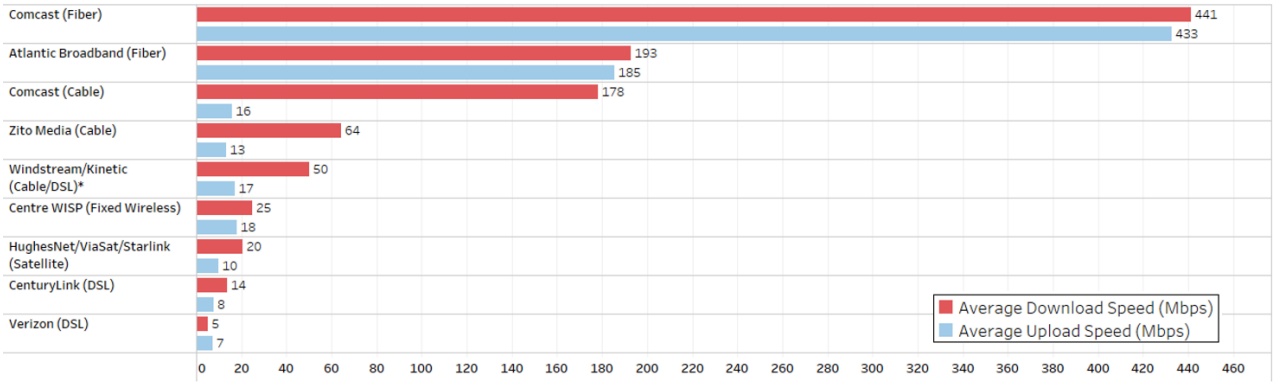
Half of the speed survey respondents report using internet services delivered through coaxial cable provided by Comcast (see Figure 11). Verizon's DSL product and Zito Media's coaxial cable products accounted for the technology utilized by over a quarter of the speed survey respondents.

Figure 11: Speed test survey results by provider and technology



While only eight tests were conducted using Comcast's fiber product, the technology far exceeded the speeds available through the County's second largest fiber provider, Atlantic Broadband/Breezeline. No results are yet available for newcomer Black Bear Fiber LLC, Centre WISP's FTTP subsidiary and the County's third fiber broadband provider, as the Snow Shoe project is still in the construction phase. Figure 12 shows the speed test results for each provider.

Figure 12: Average download and upload speeds by provider



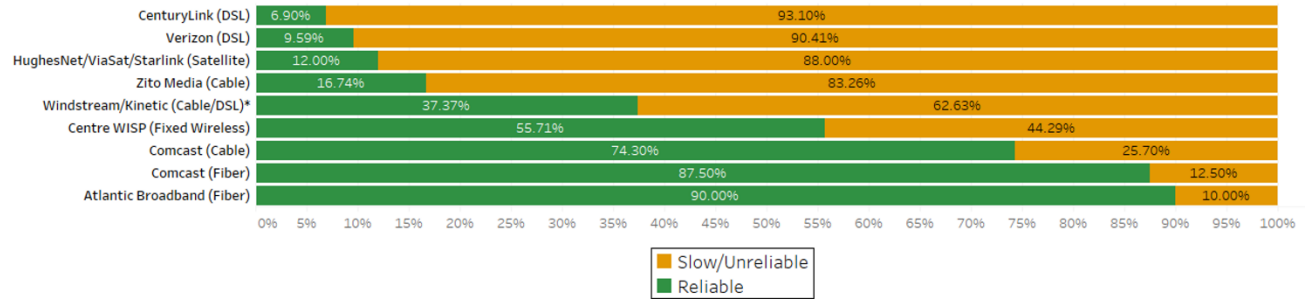
2.4.2 Cellular connectivity is an inferior substitute for wireline broadband

Fewer than a hundred speed survey results were conducted using wireless cellular technology. While the speeds for these tests had a high degree of variation, the customer satisfaction was uniformly negative, with most respondents reporting "Slow/Unreliable" service. The device indicated as used to take the survey—combined with the negative perception of coverage—indicates that these devices are often being used as hotspots for laptops or desktop computers, likely where reliable wireline broadband is not available. The test result therefore sometimes does not reflect the home connection the respondent complains about. There was not enough information captured in this survey to make any conclusive statements on mobile service in general, but it may be an area to explore further to capture how residents use mobile connectivity and their experience of it and if/how it interplays with fixed broadband connectivity options.

2.4.3 Fiber and cable technology lead in reliability with one exception

Speed survey data aligned with user claims of high reliability among futureproof fiber and cable technologies (see Figure 13).

Figure 13: Reported reliability and speed by technology



Fiber connectivity delivered by Atlantic Broadband and Comcast led the field in consumer satisfaction as gauged by whether their service was "reliable" or "slow/unreliable." While the fiber products scored the highest on speed and reliability, Comcast's cable product rounded out the top three most reliable services. Respondents found Centre WISP's fixed wireless solution to be reliable over half of the time.[17]

Responses below the 50 percent satisfaction rating utilized alternate technologies, including satellite providers that suffer from high latency, and DSL (digital subscriber line) products over copper wireline, which generally performed the lowest. The quality of service measured largely tracked with the speeds provided. However, there is one exception.

Despite the ability for coaxial cable to deliver high-speed internet connectivity, survey results indicated speeds recorded through Zito Media cable fell below those typical of the County's fixed wireless provider and were comparable to some DSL services—the lowest performing technology measured. Residents and County staff report that these low speeds are likely the result of thinning infrastructure caused by rapid expansion and the inability of outdated infrastructure to meet current capacity and demand. These results support anecdotal evidence provided by Zito Media customers during community outreach efforts (see Section 2.5.1)

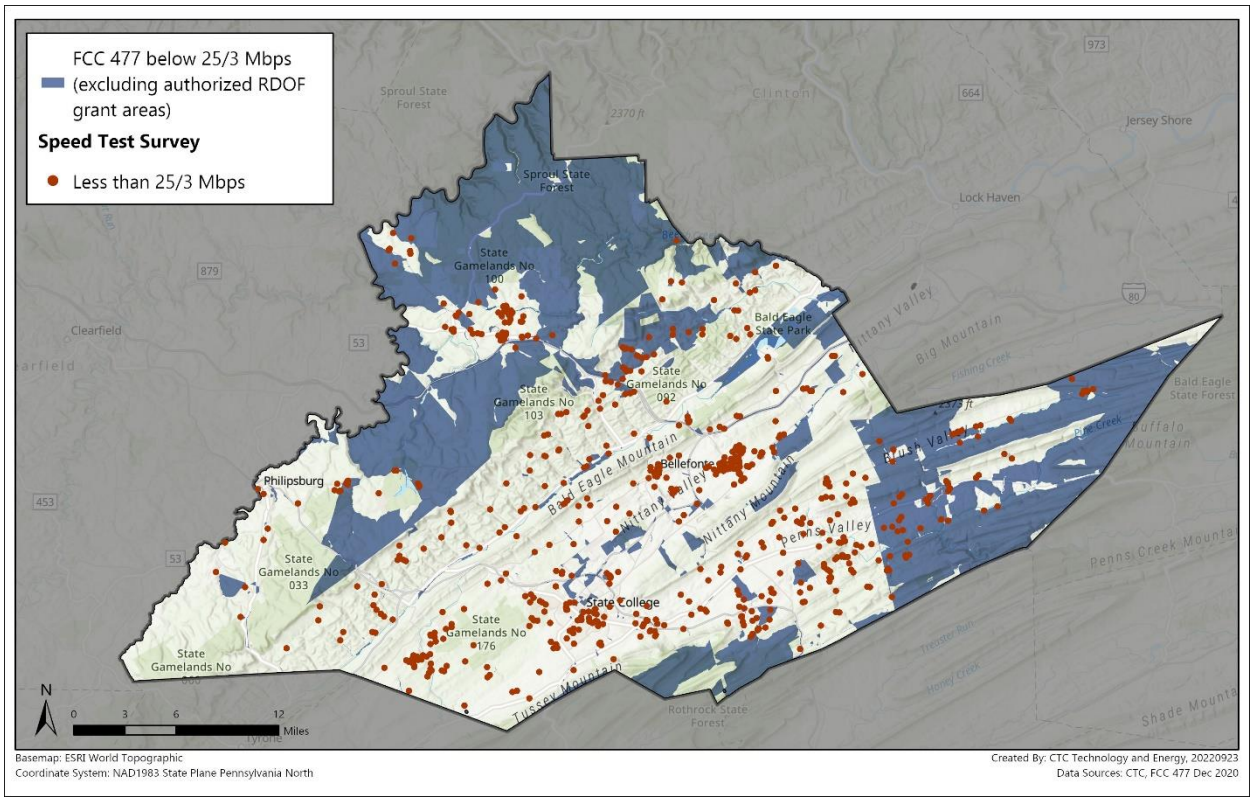
Residents reported that Zito Media used a high number of amplifiers to extend its network. When shielded copper cable (coax) or copper line technology is used, the signal attenuates creating the need to amplify the signal. However, each time an amplifier is utilized it increases the likelihood of creating errors in the network. Increasing capacity will require the cable provider to upgrade to a fiber backbone.

2.4.4 Due to the limitations of FCC Form 477 data, the new broadband serviceable locations fabric is needed for accuracy in assessing coverage

While Form 477 has been the most comprehensive national dataset for broadband availability to date, the data are far from adequate—illustrated by the lack of correlation between areas reported as unserved and speed test results shown in Figure 14. ISPs provide data directly through Form 477 to determine coverage areas, and the FCC considers a census block served by broadband if the ISP reports only one of the premises in the block as serviceable. Overall, the data tends to overestimate service availability, particularly in less populated areas where one census block may cover many square miles.

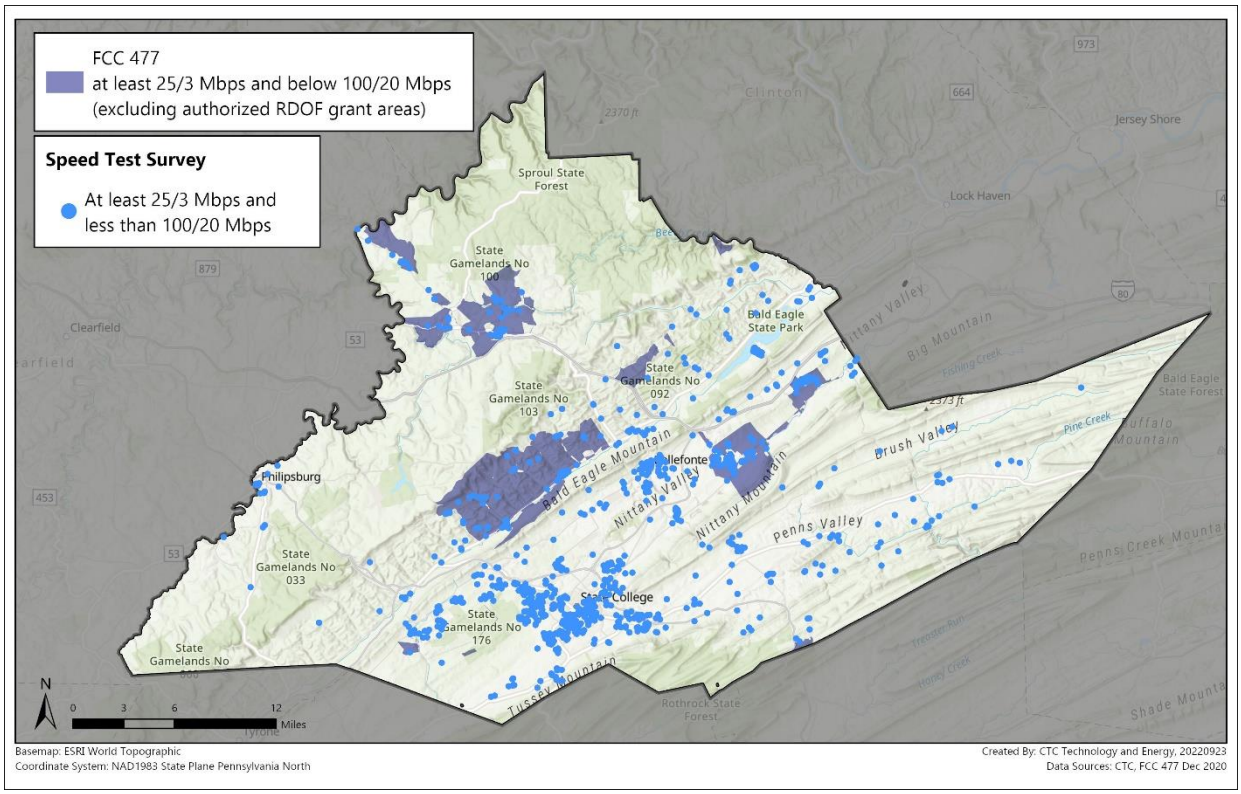
[17] This actually outperforms typical performances of fixed wireless providers, which often struggle to provide clear line-of-sight connectivity. The actual speeds recorded were low compared to cable and fiber, and barely outperformed DSL, but were perceived as more reliable. The high satisfaction could be a result of comparing it against previous satellite alternatives and good customer service. Pricing is rather steep. In many areas, the highest available plan delivers 30/6 Mbps, and will typically cost $109.99 per month on top of an installation fee of $179.50 and requires a 12-month agreement.

Figure 14: Map of FCC-reported unserved areas with speed survey results



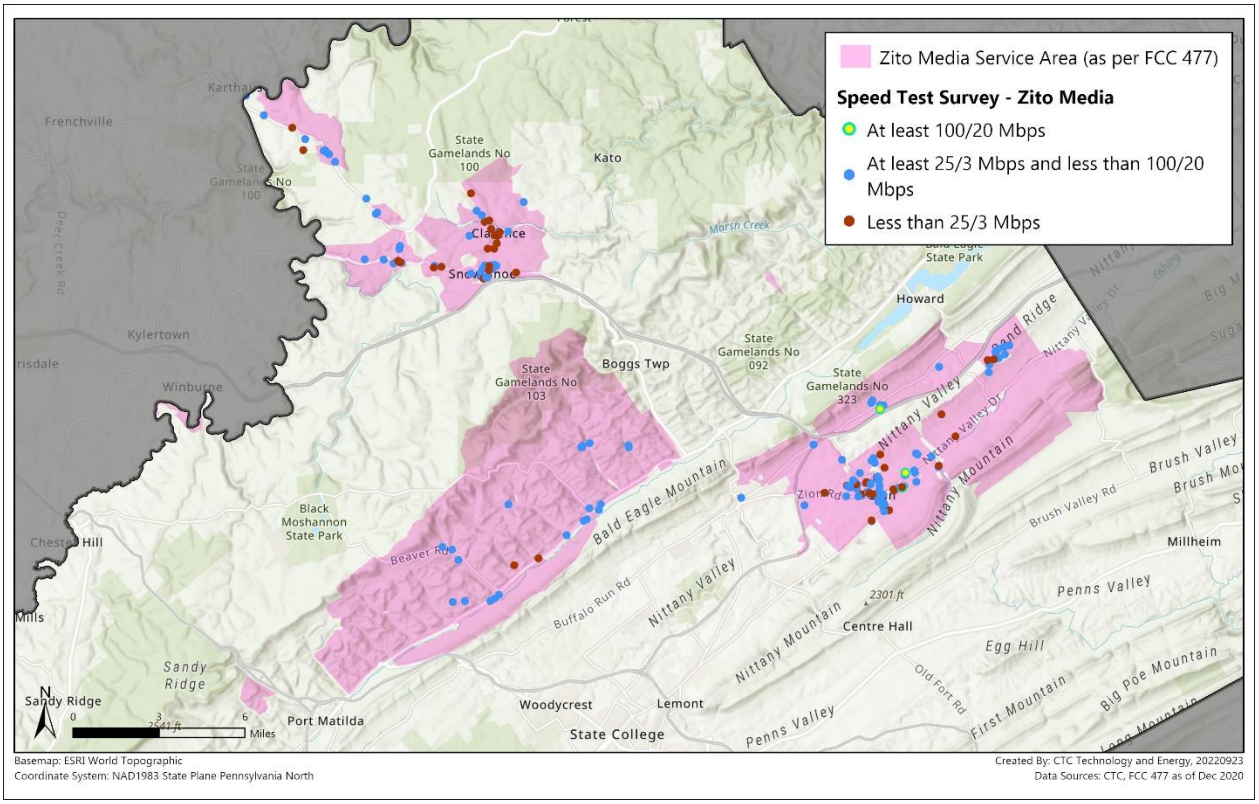
Survey data for underserved locations reveal similar shortcomings with the FCC's 477 data (see Figure 15). Speed surveys taken over nearly half of the County indicate a pervasive number of underserved locations while FCC 477 data shows only pockets of locations receiving speeds of at least 25/3 but less than 100/20.

Figure 15: Map of FCC-reported underserved areas with speed survey results



One map where Form 477 data correlates with speed survey data is in the area serviced by cable provider Zito Media. The County has received a substantial number of calls relating to lack of reliability and service falling short of promised speeds in this area. Survey results confirm the problems conveyed to the County (see Figure 16).

Figure 16: Cable infrastructure with speed data



The bi-partisan IIJA legislation enacted in November 2022 mandated the use of a new, address-level nationwide map of broadband coverage. This required the FCC to make a Broadband Serviceable Locations Fabric (or "Address Fabric") available, so there would be a single address map against which to report and track coverage. The address fabric was first made available to government agencies at the beginning of August 2022. The map will include a challenge process whereby ISPs and local governments can add or revise address locations. A new first iteration of a map with ISP coverage information will be released around November of 2022. It too will allow ISPs, governments, and eventually residents to question coverage areas with the goal of refining coverage boundaries. A second iteration of the FCC coverage map will form the basis of the map NTIA will use for the IIJA BEAD program, and will indicate unserved, underserved, as well as very high-cost areas. The State broadband office will use this map to design its grant program and establish eligibility and priorities.

2.5 Community engagement

CTC conducted two town hall meetings with County staff and community leaders. The intent of the forums was to introduce the broadband planning project, inform stakeholders of current County projects and communications efforts to date, and to gather feedback from the community on areas of concern and needs specific to various departments, industries, communities, and geographic areas. CTC and the County also held meetings with the Department

of Telecommunications at Penn State to understand its plans for an open network fiber ring connecting educational anchor institutions within the state.

2.5.1 Community town halls

It should be noted that Centre County has a highly engaged population. While residents are vocal in advocating for their own ability to access reliable, high-speed internet, they are equally interested in their neighbors receiving quality connections. A few examples of community engagement include:

- Homeowners' associations (HOA) organizing to bring broadband providers to their community
- Community spokespersons actively pursuing how their connectivity can be used to facilitate broadband in surrounding areas
- Residents offering use of their land for communications towers to provide connection to neighboring areas
- Inquiries related to the use of FirstLight's educational network (formerly KINBER) to bring broadband to unserved areas

Over the course of the two town hall meetings, gaps in service emerged. A few areas of concern captured include:

- Bellefonte is served by Comcast and to a lesser extent Zito Media. A Bellefonte resident relayed a conversation with a homeowner outside the township in which they mentioned having been quoted $37,000 by Comcast to deliver fiber to their home.
- The Mayor of Unionville inquired whether the former KINBER network could be used to service Union Township.
- A resident pointed out that some areas of the County, such as Reberburg, neighboring Madisonburg, and Potter Township have virtually no access to broadband. During the pandemic this resident's daughter experienced hardships attempting to conduct teaching remotely.
- HughesNet reception degrades on cloudy days.
- In Curtin, residents have concerns about the ability of children to access distanced learning where there is little connectivity or even cellular service.
- Huston Township is serviced by Verizon DSL. The basic package starts at $100 a month and delivers poor service that at times does not work at all. Zito Media also serves the area but does not offer much better service quality. During the pandemic, students in the area fell behind in school due to lack of connection.

- In the Julian area, Zito Media provides cable but service is unreliable. The ISP leases fiber from a firm in Pittsburgh, so technicians need to travel from a distance to address problems.
- Another resident in the Julian area was quoted $14,000 by Zito Media to run cable to their home.
- One resident near Black Moshannon monitored Zito Media's connection for 90 days and the availability never rose above 65 percent. The homeowner now uses Starlink.
- The Zion area of Bellefonte experienced similar speed and reliability issues with Zito Media service over the pandemic. In concert with Walker Township, the Zion HOA reached out to Centre WISP, which was scheduled to begin servicing the area with fiber-to-the-home in July 2022.
- The president of the Port Matilda council and Bald Eagle/Half Moon Council of Governments reported the area being serviced by Verizon DSL and Comcast cable that deliver inconsistent speeds.

2.5.2 The Pennsylvania State University

CTC met twice with Penn State's Palmer Chair in Telecommunications. Dr. Sascha Meinrath conveyed multiple concerns about the state of broadband in Pennsylvania:

- A shortage of competition is driving up costs once promotional pricing has expired.
- The lack of transparency on coverage area and actual speeds masks the true needs of communities.
- The digital divide between those who have internet access and those who do not is widening, as shown by the drop in connectivity immediately outside of State College.
- Massive infrastructure divides between counties prevent the sharing of resources.

As discussed in Section 2.3.6, Penn State is leading a consortium of higher education institutions, including Carnegie Mellon, Temple, Pittsburgh, and others, to develop a plan to connect these anchor institutions with an open access middle mile network that would provide potentially free transit and connectivity to providers looking to expand their networks across the state. While funding for the network and last mile solutions requires further consideration, the project could lend critical middle mile infrastructure to a countywide network if the timing aligned.

2.6 Engagement with providers indicates a strong interest in public-private partnerships

CTC convened six primary providers of wireline broadband, and one fixed wireless provider, within Centre County: Breezeline/Atlantic Broadband (cable/fiber), Comcast (cable/fiber), Black

Bear Fiber—a subsidiary of Centre WISP (fiber), Zito Media (cable), Verizon (DSL), and Windstream (cable/DSL). ISPs indicated a strong willingness to partner with the County in applying for upcoming grant opportunities. In addition, most of the ISPs were open to sharing data for the purpose of identifying potential broadband projects. While this data was utilized to calculate cost estimates, CTC has not shared specific proprietary data with the County.

2.6.1 Breezeline/Atlantic Broadband (fiber and cable)

Breezeline, formerly known as Atlantic Broadband, has an existing cable footprint in Centre County and is committed to building new networks using fiber with G-PON/X-PON technology. Currently located in the Milheim area, Breezeline is looking for logical extensions to its network, notably stretching from Milheim through Greg into Snider, west along Route 45 into State College. Breezeline's Francis Bradley is the Chairperson of the Broadband Cable Association of Pennsylvania. The ISP provided data for our analysis and is eager to partner with the County on future grant opportunities.

2.6.2 Black Bear Fiber/Centre WISP (fiber and fixed wireless)

Black Bear Fiber, a new subsidiary of Centre WISP, is providing fiber technology exclusively to Centre County residents. In February 2022, Black Bear Fiber was awarded funding to deploy a wireline network to serve 220 locations—with the possible addition of 628 addresses that lie outside of the project area. Black Bear Fiber will deliver up to gigabit symmetrical speeds to the Snow Shoe Township. (See Section 2.3.4.) The provider is currently investing in middle-mile construction in the greater Bellefonte area and is in negotiations with HOAs in Forest Heights and Springfield to deliver high-speed, reliable internet. This year, Black Bear Fiber/Centre WISP was awarded a UHSB grant to provide fiber optic connectivity to unserved locations in Potter Township.

Centre WISP currently provides fixed wireless connectivity in Centre County and in 2022 has decided to migrate to fiber construction in anticipation of forthcoming federal funding opportunities. Based in State College, Centre WISP has a strong relationship with its community and County leaders, and an interest in digital equity by proposing 250 Mbps symmetrical service for $50/month. The provider currently has a colocation agreement with the County for its State College data center[18] and was awarded multiple areas in the FCC's RDOF auction. Upon request, Centre WISP provided network data for our analysis.

2.6.3 Comcast/XFINITY (cable/new fiber)

Comcast's network in the County is largely comprised of coax cable with a handful of fiber builds. Its current hybrid coax network utilizes DOCSIS 3.1, and it is currently testing DOCSIS 3.4 to

[18] "SCDC1," Data Center Map, https://www.datacentermap.com/usa/pennsylvania/state-college/scdc1.html (accessed September 30, 2022.)

provide speeds of up to 10/6G. Like Breezeline, the ISP has plans to build using all fiber for future projects. It recently won multiple UHSB projects to provide fiber optic service to the townships of Potter, Curtin, and Liberty. According to the speed survey, the ISP's fiber product is highly rated among consumers. Comcast is an ongoing partner with Centre County and is eager to partner on future funding opportunities. Upon request, Comcast provided network data for our analysis.

2.6.4 Windstream (cable/new fiber)

Like Comcast and Breezeline, Windstream's rural coverage area is largely serviced by coaxial cable with plans to build fiber networks in the future. The incumbent telephone provider for Centre County, Windstream has a presence in Port Mathilda and is a competitive local exchange carrier (CLEC) in State College where, under an acquisition, the ISP is able to provide up to gig speeds over coax. Its plans are to build more fiber to the node to upgrade its network. Along with Centre WISP, Windstream was awarded areas under RDOF and has committed to building fiber beyond its existing footprint to fulfill those commitments. At the time of the interview, Windstream's network spanned 154 miles and it expressed an interest in partnering with the County for grant opportunities to extend outwards from its existing network. Windstream provided network data for our analysis.

2.6.5 Zito Media (cable)

Zito Media's presence in Centre County consists primarily of hybrid fiber coax (HFC) utilizing DOCSIS 3.0 with the intention to upgrade to version 3.1. Its strategy for upgrading its network to address connectivity issues is to build fiber deeper into more nodes to make connections more robust. It is actively working to address customer concerns by outsourcing some customer service to scale its support. Zito Media acquired assets from Telemedia at some point but said it had no intentions of upgrading to fiber within the first five years since acquisition. Upon request, Zito Media provided network data for our analysis and expressed a strong interest in partnering with the County. Understanding the timing and location of Zito Media's planned upgrades will be of importance as the County undertakes a Countywide approach to filling its broadband gaps.

2.6.6 DSL and fixed wireless providers

2.6.6.1 Verizon

Verizon's footprint in Centre County consists solely of DSL service delivered on copper lines. According to ISP representatives, Verizon has little if any fiber in the County.

2.6.6.2 Upward Broadband

Upward Broadband is strictly a wireless ISP (WISP) in Centre County. Currently deployed in the neighboring counties of Huntingdon, Fulton and Bedford, the provider is interested in expanding its footprint in Centre County. Upward Broadband has received funding for tower construction in the areas of Pine Grove Mills (covering an area north to State College), the Beech

Creek/Blanchard area (covering Blanchard, Howard, and some of Nittany), and a tower in Clinton planned for 2023. In February 2022, Upward Broadband was awarded $15.44 million by Huntingdon County and funded by an NTIA grant to build 20 towers in Huntingdon to reach unserved areas.[19]

Current service plans for Upward Broadband provide low speeds at high prices, as is the nature of fixed wireless where construction is costly and the take-rate low. Although the ISP does not provide a low-cost tier, it does participate in the Affordable Connectivity Program (ACP), which provides a $30 credit to households that qualify for low-income subsidies.

While IIJA/BEAD funding opportunities favor futureproof technology, it will be important to keep abreast of the expansion plans for fixed wireless expansion given the anticipated high cost of reaching Centre County's northern rural areas with fiber. Upon request, Upward Broadband provided network data for our analysis and expressed an interest in future partnerships.

2.6.7 Potential broadband providers FirstLight, All Points Broadband (APB), and Shentel

FirstLight has submitted a grant proposal to the National Telecommunications and Information Administration (NTIA) for a Middle Mile grant to extend its network in Centre County.[20] The project would build capacity on FirstLight's 1,800-mile fiber optic network, which connects educational institutions as a result of its acquisition of Keystone Initiative for Network Based Education and Research (KINBER) assets completed in March of this year.[21] FirstLight is a middle mile carrier providing services to enterprise customers as well as other carriers and last-mile providers. It is therefore not a candidate for last mile residential service provision. But should it become successful in its grant applications and expansion efforts, it could facilitate last-mile providers to expand services in the County.

All Points Broadband (APB) currently serves Virginia, West Virginia, and Kentucky. During a meeting with representatives, APB expressed a strong interest in moving into Pennsylvania and have identified Centre County as a marquee area it would like to use as a launch point for a regional network. The ISP cited its rapid expansion and successful grant writing capabilities to position itself as an optimal partner. APB is in the process of overbuilding its wireless network

[19] Upward Broadband Receives NTIA Funding to Expand High-Speed Broadband Access to Over 7,500, https://www.upwardbroadband.com/upward-broadband-receives-ntia-funding-to-expand-high-speed-broadband-access-to-over-7500/ (accessed October 2, 2022)
[20] State College.com, "Company Looks For Grant To Expand Broadband In County," September 29, 2022 https://www.statecollege.com/centre-county-gazette/company-looks-for-grant-to-expand-broadband-in-county/ (accessed October 2, 2022.)
[21] GlobeNewswire, "FirstLight Completes Acquisition of KINBER Assets," March 30, 2022, https://www.globenewswire.com/en/news-release/2022/03/30/2413001/0/en/FirstLight-Completes-Acquisition-of-KINBER-Assets.html (accessed October 2, 2022).

with fiber, utilizing XGS-PON technology. Representatives discussed a track record of successful partnerships with electric companies and localities. They suggest an aerial approach typically employing an 80/20 (aerial/underground) split.

Shentel, originally the Shenandoah Telecommunications Company, is another regional provider that is interested in expanding deeper into Pennsylvania. The company has growing networks in Virginia, West Virginia, Maryland, Pennsylvania, Delaware, and Kentucky. Shentel has a history of building networks in areas that share similar challenges as Centre County with regards to terrain and focus on rural areas, but has also more recently expanded into urban markets to compete with fiber against incumbent cable companies.

2.7 Community infrastructure and market assessment: Residential broadband services and pricing

CTC's market assessment involves data collection and analysis of where fiber, cable, DSL, and fixed wireless internet services exist, and the service offerings and pricing available to consumers. Comparing costs across similar technologies helps to examine whether service is competitively priced. This analysis is also critical when thinking ahead to Digital Equity funding provided under BEAD. This funding will be predicated on a project's ability to address affordability and accessibility with regard to residents who qualify for low-income assistance.

The analysis starts with the FCC's Form 477 data, which maps services offered at the census block level. The project team then researched websites of broadband providers operating in Centre County to confirm whether service is available, and in some cases engaged in phone conversations with representatives of ISPs to collect market data on residential broadband pricing and availability. The pricing reported is, in all cases, the non-promotional pricing and disregards initial promotional rates. All research was conducted in September 2022, and prices and plans are subject to change.

Research was conducted to identify the services and pricing offered by nine of the primary residential ISPs in Centre County:[22]

- **Black Bear Fiber** (a subsidiary of Centre WISP) provides fiber broadband services
- **Windstream/Kinetic** provides cable broadband services, soon to offer fiber
- **Breezeline/Atlantic Broadband** provides fiber and cable broadband services
- **Comcast** provides cable broadband services and fiber in select areas
- **CenturyLink** provides DSL

[22] Several attempts were made to contact CenturyLink, a cable provider in the County; however, CTC was not able to obtain a reliable pricing quote.

- **Zito Media** provides cable broadband services
- **Verizon** provides DSL
- **Centre WISP** provides fixed wireless services
- **Upward Broadband** provides fixed wireless services

2.7.1 Fiber broadband services

Black Bear Fiber offers three fiber packages throughout the County with advertised speeds of 100/100 Mbps, 500/500 Mbps, and 1000/1000 Mbps, ranging from $30 to $105 per month. The 100/100 Mbps plan is free with enrollment in the ACP. Table 2 summarizes the services offered.

Table 2: Residential fiber service offered by Black Bear Fiber

Advertised download/upload speeds	Monthly price (non-promotional)[23]
100/100 Mbps	$30.00
500/500 Mbps	$70.00
1000/1000 Mbps	$105.00

Windstream offers four speed tiers throughout the County, with three primary packages—Kinetic Internet 200, 400, and 1000, which offer speeds of 200/200 Mbps, 400/400 Mbps, and 1000/1000 Mbps, respectively, and range from $25 to $55 monthly. Windstream also offers a premium package, Kinetic ONE Internet 300, that provides speeds of 300/300 Mbps for $70. Windstream's two premium packages, Kinetic ONE and Kinetic ONE Premier, offer the same speeds at a higher price but include free installation and paperless billing. Table 3 summarizes the services offered.

Table 3: Residential fiber service offered by Windstream

Service	Advertised download/upload speeds	Monthly price (non-promotional)	Notes
Kinetic Internet 200	200/200 Mbps	$55.00	Does not include a $14.99 monthly equipment rental fee, $50 service activation fee, or $35 installation fee. New customers receive a $100 credit on

[23] Includes all taxes and fees. No installation fee or equipment rental required. No minimum contract term. Pay for 11 months upfront and get 1 month free.

Service	Advertised download/upload speeds	Monthly price (non-promotional)	Notes
			their first monthly statement
Kinetic ONE Internet 300	300/300 Mbps	$70.00	Does not include a $14.99 monthly equipment rental fee or $50 service activation fee. Free installation. New customers receive a $100 credit on their first monthly statement.
Kinetic Internet 400	400/400 Mbps	$75.00	Does not include a $14.99 monthly equipment rental fee, $50 service activation fee, or $35 installation fee. New customers receive a $100 credit on their first monthly statement
Kinetic Internet 1000	1 Gig/1Gig	$85.00	Does not include a $14.99 monthly equipment rental fee, $50 service activation fee, or $35 installation fee. New customers receive a $100 credit on their first monthly statement

Breezeline, formerly Atlantic Broadband, offers three main fiber speed tiers throughout the County. Fiber Fast, Fiber UltraFast, and Fiber GigaFast services offer speeds of 200/200 Mbps, 500/500 Mbps, and 1000/600 Mbps, respectively, with monthly subscription costs that range from $87.19 to $130.39. Table 4 summarizes the services offered.

Table 4: Residential fiber service offered by Breezeline

Service	Advertised download/upload speeds	Monthly price (non-promotional)	Notes
Fiber Fast	200/200 Mbps	$87.19	Price includes a $10 monthly automatic payment and paperless billing discount. Additional $14.99 monthly equipment rental fee. No installation fee. Customers receive a $150 gift card with purchase.
Fiber UltraFast	500/500 Mbps	$108.79	
Fiber GigaFast	1000/600 Mbps	$130.39	

2.7.2 Cable broadband services

Breezeline, formerly Atlantic Broadband, offers four speed tiers of cable broadband throughout the County. Base, Fast, UltraFast, and GigaFast services offer speeds of 100/5 Mbps, 200/10 Mbps, 500/50 Mbps, and 1000/100 Mbps, respectively, with monthly subscription costs that range from $65.59 to $130.39. All four speed tiers offer a lower twelve-month promotional price that includes a $10 automatic billing and EcoSave paperless billing discount, and customers receive a $100 gift card with their subscription. Table 5 summarizes the services offered.

Table 5: Residential cable broadband service offered by Breezeline

Service	Advertised download/upload speed	Monthly price (non-promotional)	Notes
Base	100/5 Mbps	$65.59	Promotional price for the first 12 months is $19.99 (includes $10 autopay and paperless billing discount that can be applied past the promotional period). $14.99 monthly equipment rental fee. No installation fee. $100 gift card with purchase.
Fast	200/10 Mbps	$87.19	12-month promotional price is $39.99 (includes $10 autopay and paperless billing discount that can be applied past the promotional period). $14.99 monthly equipment rental fee. No installation fee. $150 gift card with purchase.
UltraFast	500/50 Mbps	$108.79	12-month promotional price is $39.99 (includes $10 autopay and paperless billing discount that can be applied past the promotional period). $14.99 monthly equipment rental fee. No installation fee. $150 gift card with purchase.
GigaFast	1000/100 Mbps	$130.39	12-month promotional price is $59.99 (includes $10 autopay and paperless billing discount that can be applied past the promotional period). $14.99 monthly equipment rental fee. No installation fee. $150 gift card with purchase.

Comcast offers seven speed tiers throughout the County. The Performance Starter Internet and Performance Internet packages offer speeds of 50/10 Mbps and 100/10 Mbps for $65 and $84 with no term agreement required. Performance Pro Internet, Blast! Internet, Extreme Pro Internet, and Gigabit Internet offer speeds ranging from 300/10 Mbps to 1200/35 Mbps,

respectively. The monthly subscription costs for these plans range from $99 to $114; Comcast also offers a lower 24-month promotional price which includes a $10 monthly automatic payments and paperless billing discount. The final plan, Gigabit Pro Internet, offers speeds of 6000/6000 Mbps for $299.95 with a two-year agreement. Table 6 summarizes the services offered.

Table 6: Residential cable broadband service offered by Comcast

Service	Advertised download/upload speeds	Monthly price (non-promotional)	Notes
Performance Starter Internet	50/10 Mbps	$65.00	No minimum term contract. Does not include $14 monthly equipment rental fee. $100 installation fee.
Performance Internet	100/10 Mbps	$83.95	No minimum term contract. Does not include a $14 monthly equipment rental fee. $100 installation fee.
Performance Pro Internet	300/10 Mbps	$98.95	Does not include $14 monthly equipment rental fee. $100 installation fee.
Blast! Internet	600/20 Mbps	$103.95	$59.99 per month for the first 24 months with no term agreement (includes $10 per month automatic payments and paperless billing discount; regular rate for years 1-2 is $69.99 per month). Does not include $14 monthly equipment rental fee. $100 installation fee.
Extreme Pro Internet	900/20 Mbps	$108.95	$69.99 per month for the first 24 months with no term agreement (includes $10 per month automatic payments and paperless billing discount; regular rate for years 1-2 is $79.99 per month). Does not include $14 monthly equipment rental fee. $100 installation fee.
Gigabit Internet	1200/35 Mbps	$113.95	$79.99 per month for the first 24 months with no term agreement (includes $10 per month automatic payments and paperless billing discount; regular rate for years 1-2 is $89.99 per month). Does not include $14 monthly equipment rental fee. $100 installation fee.
Gigabit Pro Internet	6000/6000 Mbps	$299.95	Price with two-year agreement. Does not include $14 monthly equipment rental fee. $500 installation fee.

Zito Media claims to offer four speed tiers throughout the County; however, their service territory seems to be overrepresented. Research by the project team revealed Zito Media services a limited number of addresses. Zito's Super-Speed Internet & Voice, Ultra-Speed Internet & Voice, Mega-Speed Internet & Voice, and High-Speed Internet (speeds up to 1 Gig) plans offer speeds of 50/5 Mbps, 100/10 Mbps, 200/15 Mbps, and 1000/20 Mbps. The monthly subscription costs for these plans range from $39.95 to $75. Table 7 summarizes the services offered.

Table 7: Residential cable broadband service offered by Zito Media[24]

Service	Advertised download/upload speeds	Monthly price (non-promotional)	Notes
Super-Speed Internet & Voice	50/5 Mbps	$70	$39.95 per month for six months with no contract, or lock in this promotional price for two years with a contract. After two years, the price returns to the current package price ($70).
Ultra-Speed Internet & Voice	100/10 Mbps	$80	$49.95 per month for 6 months with no contract, or lock in this promotional price for two years with a contract. After two years, the price returns to the current package price ($80).
Mega-Speed Internet & Voice	200/15 Mbps	$95	$64.95 per month for six months with no contract, or lock in this promotional price for two years with a contract. After two years, the price returns to current package price ($95).
High Speed Internet (Speeds up to 1 Gig)	1000/20 Mbps	$100	$75.00 per month for six months with no contract, or lock in this promotional price for two years with a contract. After two years, the price returns to the current package price ($100).

[24] Pricing as of May 2022

2.7.3 Fixed wireless broadband services

Centre WISP offers six speed tiers throughout the County. Boost 50 and Boost 100, its base plans, offer speeds of 50-100/16-20 Mbps and 100-200/33-66 Mbps at monthly subscription costs of $50 and $80. Centre WISP also offers four primary service plans with varying speeds and prices. Certain plans require different minimum contract terms based on location and may require installation fees. Two customers may therefore pay different monthly amounts based on their location, despite having the same service package. Table 8 summarizes the services offered.

Table 8: Residential fixed wireless service offered by Centre WISP

Service	Advertised download/upload speeds	Monthly price (non-promotional)	Notes
Boost 50	50-100/16-20 Mbps	$50.00	Minimum 12-month contract term. If cancelled before 12 months, customer is subject to buyout fees up to $200. No installation fee.
Boost 100	100-200/33-66 Mbps	$80.00	Minimum 12-month contract term. If cancelled before 12 months, customer is subject to buyout fees up to $200. No installation fee.
Basic Residential	5/1 Mbps	$35.00-$40.00	Monthly price will depend on household location. Minimum 12-month contract term. If plan is cancelled before 12 months, customer is subject to buyout fees up to $200. No installation fee.
Bronze Residential	10/1-2 Mbps	$59.99-$69.99	
Silver Residential	15-20/3-4 Mbps	$79.99-$89.99	
Gold Residential	30-40/6-8 Mbps	$99.99-$109.99	

Upward Broadband offers four speed tiers throughout the County. Performance and Performance Plus offer speeds of 10/2 Mbps and 25/5 Mbps at monthly subscription costs of $49.95 and $69.95, and Performance Pro offers speeds of 50/10 Mbps with a monthly subscription cost of $99.95. The last speed tier, Performance Premium, offers speeds of 100/20 Mbps, but the monthly subscription cost increases substantially to $299.95. Table 9 summarizes the services offered.

Table 9: Residential fixed wireless service offered by Upward Broadband

Service	Advertised download/ upload speeds	Monthly price (non-promotional)	Notes
Performance	10/2 Mbps	$49.95	Does not include a one-time $149 activation fee or a $6 monthly equipment fee.
Performance Plus	25/5 Mbps	$69.95	
Performance Pro	50/10 Mbps	$99.95	Does not include a one-time $99 activation fee or a $6 monthly equipment fee.
Performance Premium	100/20 Mbps	$299.95	

2.7.4 DSL broadband services

Verizon Wireless offers two digital subscriber line (DSL) home internet packages in Centre County. One package claims to offer up to 7 Mbps download and up to 7 Mbps upload speeds. The second package reports services of 3 Mbps download and 1-7 Mbps for upload. However, both packages cost $74.99 regardless of the speeds available, so customers will pay the same amount for a variety of speeds. Service prices are illustrated below in Table 10.

Table 10: Residential DSL services offered by Verizon

Advertised download/upload speeds	Monthly price (non-promotional)	Notes
384 Kbps-7 Mbps/ 384 Kbps-7 Mbps	$74.99	$99 installation fee. Modem router is $29.99 or $9.99 over three installments. No minimum contract term.
3/1-7 Mbps	$74.99	$99 installation fee. No minimum contract term.

3. High-level fiber-to-the-premises network design and cost estimate

3.1 Fiber design and cost estimate

CTC engineers developed a conceptual, high-level fiber-to-the-premises outside plant network design and cost model for the County that is aligned with best practices in the industry and able to support a variety of electronic architecture options and business plans.

We present two designs:

- **Model A** assumes a standalone design to reach all the unserved addresses within the County
- **Model B** assumes a standalone design to reach all of the unserved and underserved addresses within the County

The cost of building an FTTP network will depend on what percentage of the network infrastructure is built on aerial poles as opposed to inside underground conduit. Both models assume that the deployment will seek to maximize the use of utility poles with 73 percent aerial construction and 27 percent underground construction throughout the County.

The total implementation cost of Model A is estimated to be approximately $121.4 million. The backbone and distribution plant, including core network electronics, would cost $117.1 million—or $27,370 per passing—with a 15 percent contingency cost. Distribution network electronics, subscriber drops, and customer premises equipment (CPE) for Model A at a 60 percent take-rate would cost an estimated $4.2 million, or $1,650 per subscriber.

Model B would cost an estimated $149.1 million to implement, including approximately $142.5 million for the backbone and distribution plant including core network electronics, or $18,060 per passing (also with a 15 percent contingency). Distribution network electronics, subscriber drops, and CPE for Model B at a 60 percent take-rate would cost an estimated $6.6 million, or $1,400 per subscriber. These costs are outlined in Table 11.

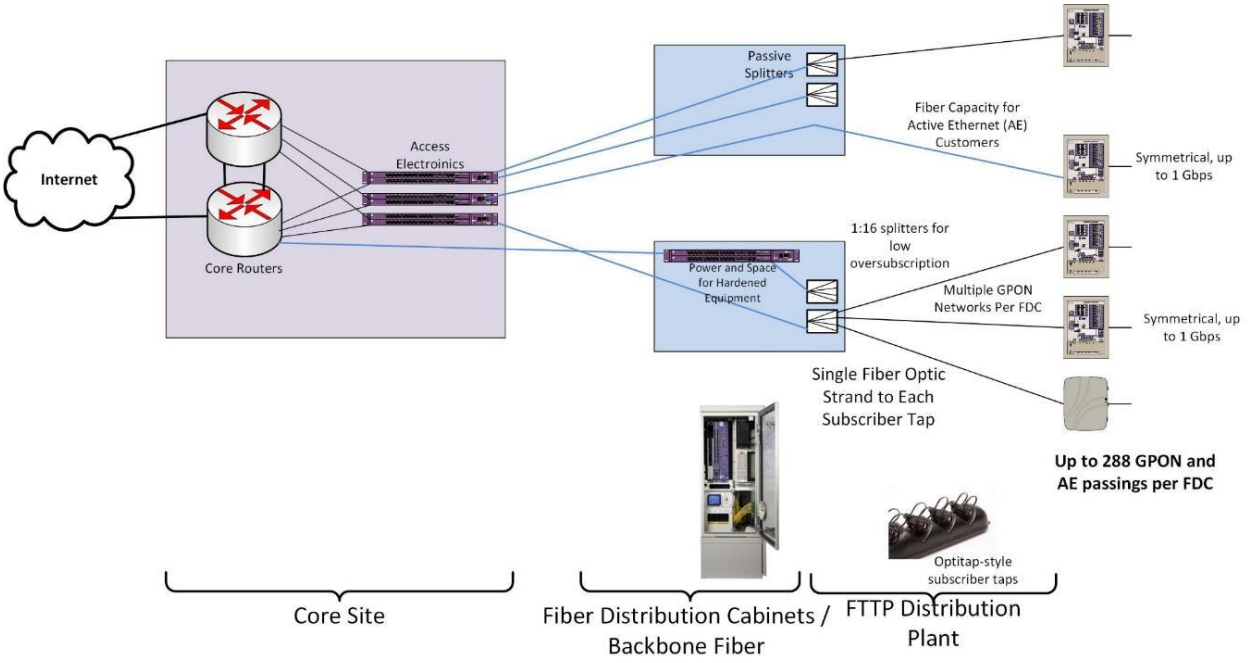
Table 11: Cost estimate summary

	Model A	Model B
Backbone and distribution plant	$117,150,000	$142,500,000
Number of passings	4,280	7,890
Cost per passing	***$27,370***	***$18,060***
Distribution network electronics, subscriber drops, and CPE (60 percent take-rate)	$4,250,000	$6,600,000
Number of subscribers (60 percent take-rate)	2,568	4,734
Cost per subscriber	***$1,650***	***$1,400***
Total implementation cost (with 15 percent contingency)	**$121,400,000**	**$149,100,000**

3.2 Network architecture

CTC developed a conceptual, high-level fiber-to-the-premises outside plant network design that is aligned with best practices in the industry and is open to a variety of electronic architecture options.[25] Figure 17, below, shows a logical representation of the fiber-to-the-premises network architecture we recommend based on the conceptual outside plant design.

Figure 17: High-level fiber-to-the-premises architecture



[25] The network's outside plant is both the most expensive and the longest-lasting portion of the deployment. The architecture of the physical plant determines the network's scalability for future uses and how the plant will need to be operated and maintained; the architecture is also the main determinant of the total cost of the deployment.

This drawing illustrates the primary functional components in the fiber-to-the-premises network, their relative position to one another, and the flexibility of the architecture to support multiple subscriber models and classes of service.

The recommended architecture is a hierarchical data network that would provide scalability and flexibility, both in terms of initial network deployment and ability to accommodate the increased demands of future applications and technologies. The central characteristics of FTTP data network include:

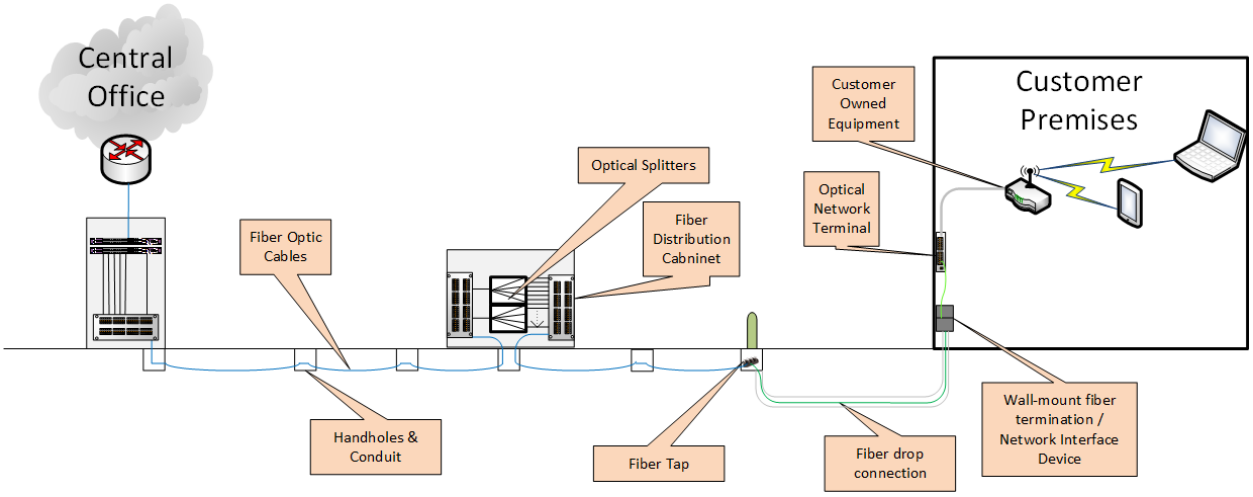
- **Capacity** – ability to consistently provide efficient transport for subscriber data at advertised speeds, even at peak times
- **Availability** – high levels of redundancy, reliability, and resiliency; the ability to quickly detect faults and reroute traffic
- **Efficiency** – no traffic bottlenecks; efficient use of resources
- **Scalability** – ability to grow in terms of physical service area and increased data capacity, and to integrate newer technologies without new construction
- **Flexibility** – ability to provide different levels and classes of service to different customer environments; can support an open access network or a single-provider network; can provide separation between service providers on the physical layer (separate fibers) or logical layer (separate Virtual Local Area Network (VLAN) or Virtual Private Network (VPN) providing networks within the network)
- **Security** – controlled physical access to all equipment and facilities, plus network access control to devices

This architecture offers scalability to meet long-term needs. It is consistent with best practices for either a standard or an open-access network model to provide customers with the option of multiple network service providers. This design would support the current industry standard Gigabit Passive Optical Network (GPON) technology, as well as 10 Gbps XGS-PON and NG-PON2 standards. It could also provide the option of direct Active Ethernet (AE) services on a limited basis, such as for business customers, using spare fiber capacity built into the designs.

The design is based on a Gigabit Passive Optical Network (GPON) architecture, which is the most commonly provisioned fiber-to-the-premises service—used, for example, by AT&T Fiber, Verizon (in its FiOS systems), and Google Fiber. GPON supports high-speed broadband data and is easily leveraged by triple-play carriers for voice, video, and data services.

GPON uses passive optical splitting, which is performed inside fiber distribution cabinets (FDC), to connect fiber from the Optical Line Terminals (OLTs) to the customer premises where it connects to an Optical Node Terminal (ONT) on the outside or inside of the premises. With GPON service (see Figure 18), the FDCs house multiple optical splitters, each of which splits the fiber link to the OLT between 16 to 32 customers. The GPON OLT uses single-fiber (bi-directional) modules called SFPs (Small Form Factor Pluggable) which consists of a laser transmitter and a receiver to support multiple (fewer than 32) subscribers, so each customer receives a fiber connection all the way to the premises.

Figure 18: GPON fiber network with a buried service drop



The design assumes placement of manufacturer-terminated fiber tap enclosures within the public right-of-way or easements, providing watertight fiber connectors for customer service drop cables, and eliminating the need for service installers to perform splices in the field. This is an industry-standard approach to reduce both customer activation times and the potential for damage to distribution cables and splices.

3.3 Assumptions and criteria

The cost of building an FTTP network will depend in large part on what percentage of the network infrastructure is built on aerial poles as opposed to inside underground conduit. In both models, we assume the County will seek to maximize the use of utility poles with 73 percent aerial overhead construction and 27 percent underground construction.

The fiber-to-the-premises network design was developed with the following criteria based on the above assumptions and required characteristics of the hierarchical fiber-to-the-premises network:

- Underground conduit and fiber will be installed in the public right-of-way or in an easement on the side of the road.
- The aerial fiber design will make use of existing poles where possible.
- Backbone fiber sizes will range from 144- to 288-count cables; extended lateral fiber sizes will range from 48- to 144-count cable; and short lateral and drop fiber will contain 12 strands.
- The network will target up to 288 passings per secondary distribution point, each served from an FDC containing optical splitters.
- The distribution plant will terminate at multi-port subscriber tap terminals (i.e. “taps”) in underground handholes, each serving no more than 12 homes.
- Access conduit will be placed in drop access handholes placed at the edge of the parcel for each serviceable passing (one handhole per one or two passings).
- The underground vault spacing along distribution routes will be no more than 750 feet.
- Where possible, the distribution plant network routes will avoid crossing major roadways, railways, and waterways.
- In the aerial design, we assume that the builder is able to obtain an attachment agreement from the pole owner.

Figure 19 below shows the conceptual architecture for the physical plant in the fiber-to-the-premises network. A hub will feed primary distribution conduit through distribution vaults located throughout the County. Some distribution vaults will be designated as equipment vaults, which contain splitters to feed secondary distribution conduit to tap access handholes located near residents. Each tap access handhole will then connect to drop access handholes located on the edge of the parcel but still within the County’s right-of-way. By installing infrastructure all the way to the edge of each premises parcel, costs are reduced the costs for future installation to a subscriber.

Figure 19: Conceptual design for the fiber-to-the-premises network

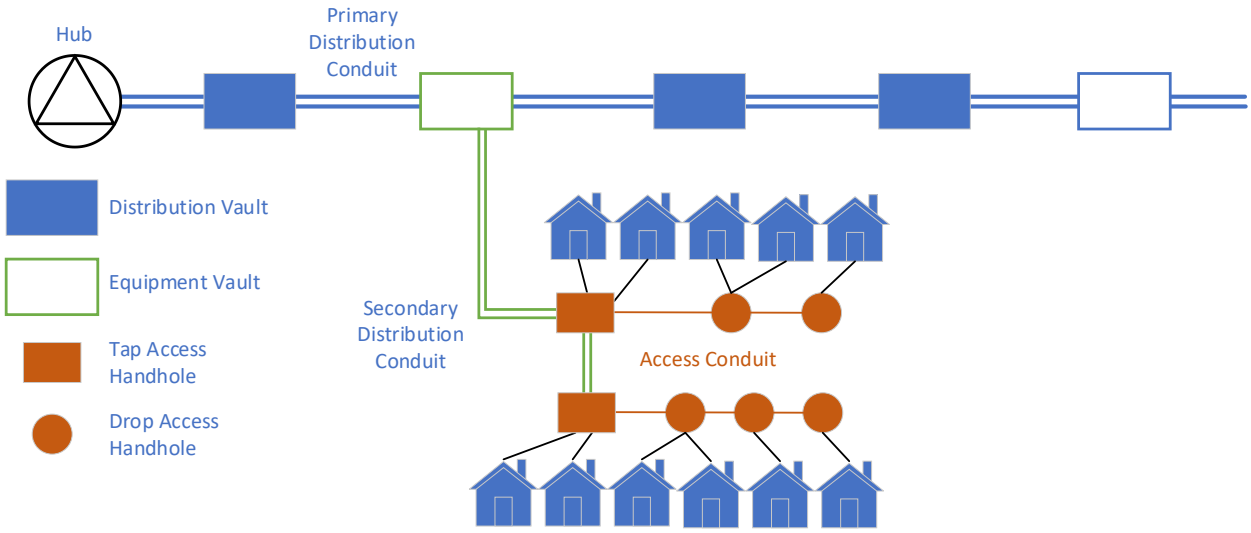
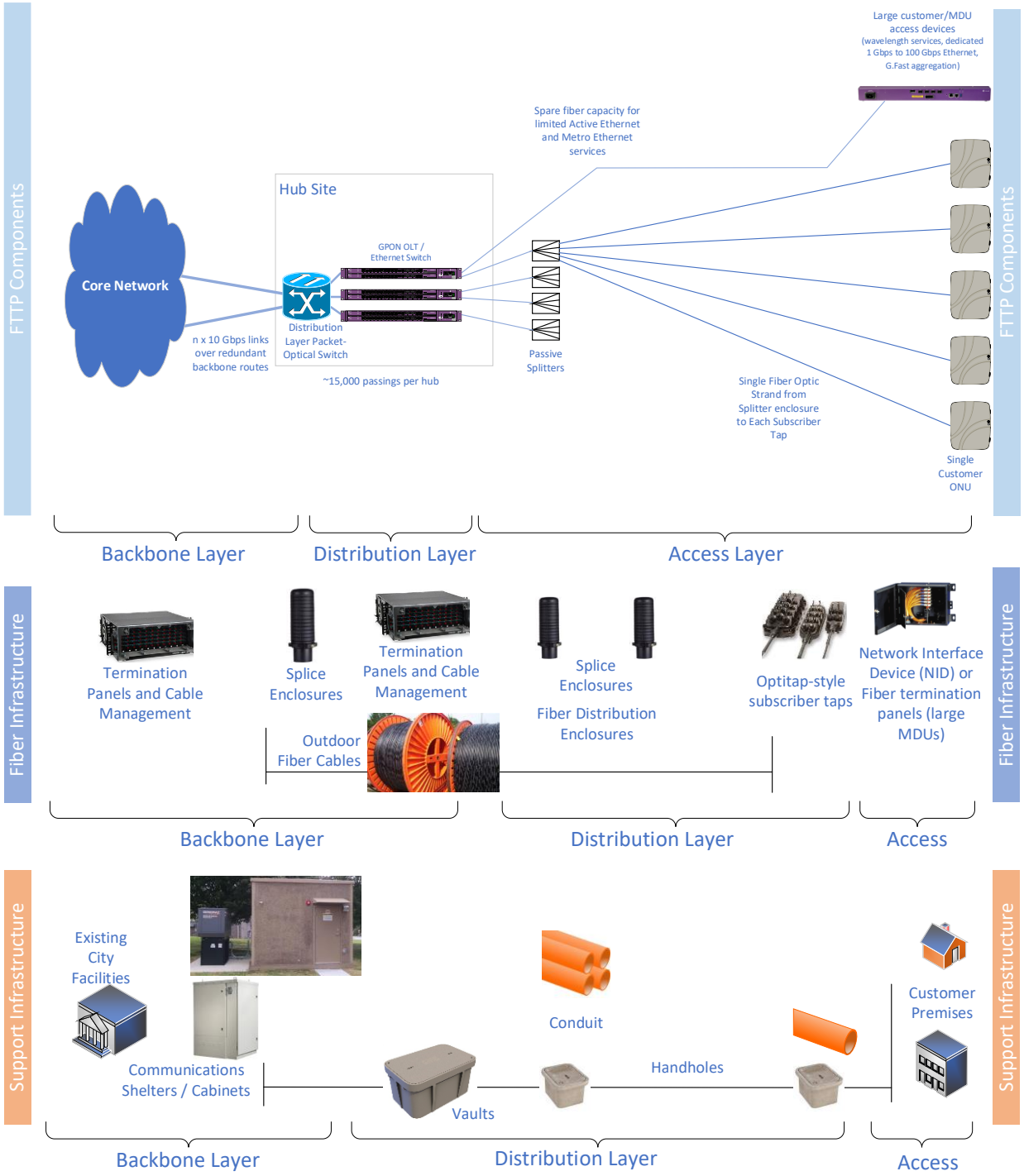


Figure 20 shows a logical representation of the fiber-to-the-premises network architecture we recommend based on the conceptual outside plant design. It also illustrates the primary functional components in the fiber-to-the-premises network, their relative position to one another, and the flexibility of the architecture to support multiple subscriber models and classes of service.

Figure 20: High-level fiber-to-the-premises architecture and components



3.3.1 Deployment costs for a countywide network

The cost for the backbone and distribution plant contains the following elements:

- **Project management** encompasses overall project and contract management, including oversight of the construction and engineering contractor(s), equipment suppliers, and right-of-way agreements. We assumed a 2-person project management team for three years.
- **Engineering and as-builts** includes system-level architecture planning, preliminary designs, and field walk-outs to determine candidate fiber routing; development of detailed engineering prints and preparation of permit applications; and post-construction "as-built" revisions to engineering design materials.
- **Conduit and vault infrastructure** consists of all labor and materials related to underground communications conduit construction, including conduit placement, vault/handhole installation, and surface restoration; and includes all work area protection and traffic control measures inherent to roadway construction activities.
- **Utility pole make-ready** consists of the labor needed for preparing poles for the addition of new aerial cabling. This includes moving existing cables to make room for new cables or replacing poles if the existing pole is at maximum capacity.
- **Fiber optic cables and components** consists of the material and labor costs specific to the installation of fiber optic cables, taps, splice enclosures, and other related components, irrespective of the cable pathway (underground conduit or aerial placement).
- **Fiber splicing, testing, and documentation** includes all labor related to splicing of outdoor fiber optic cables.
- **Hub facilities and systems** consists of the material and labor costs of placing cabinet to house hubsite electronics and terminating backbone fiber cables within the hubs.
- **Post-Covid-19 market demand contingency** accounts for price increases on material due to supply chain interruptions during the Covid-19 pandemic. This contingency is not applied to the project management and engineering and as-builts categories because they do not incorporate construction material.

We also provide the estimated cost for subscriber drops. This represents the cost of material and labor for installing aerial or underground infrastructure across a subscriber's property. This cost does not include any customer premises equipment (CPE), such as a modem.

3.3.1.1 Model A design for unserved locations

When taking all these considerations into account, the total backbone and distribution plant cost of the design to reach the county's 4,280 unserved addresses is approximately $117.1 million—or $27,370 per passing—with a 15 percent contingency. This cost is itemized in Table 12. Note that the costs have been rounded.

Table 12: Estimated countywide backbone and distribution plant cost for unserved locations

Fixed costs	
Project management	$900,000
Engineering and as-builts	$12,900,000
Conduit and vault infrastructure	$52,950,000
Materials	*$10,600,000*
Labor	*$42,350,000*
Aerial strand	$9,100,000
Materials	*$2,350,000*
Labor	*$6,750,000*
Utility pole make-ready	$3,650,000
Fiber optic cables and components	$22,500,000
Materials	*$14,750,000*
Labor	*$7,750,000*
Fiber splicing, testing, and documentation	$600,000
Hub facilities and systems	$500,000
Core network electronics	$650,000
Backbone and distribution plant total cost	**$103,750,000**
Post-Covid-19 market demand contingency on construction material (15%)	$13,400,000
Backbone and distribution plant total cost with contingency	**$117,150,000**
Number of passings	4,280
Cost per passing	**$27,370**

Table 13 presents the estimated costs for FTTP distribution electronics, subscriber drops, and CPE. As not all addresses will choose to sign up for service, we have estimated a take-rate of 60 percent—or 2,568 subscribers.

Table 13: Estimated distribution network electronics, subscriber drop, and CPE costs (FTTP Model A)

Cost element	**Cost**
FTTP distribution network electronics	$550,000
Subscriber drop costs (including MDU wiring)	$2,500,000
Customer premises equipment	$1,200,000
Total cost	$4,250,000
Total cost per subscriber	$1,650

Table 14 presents the estimated total implementation costs for Model A, assuming a 60 percent take-rate. The total implementation costs are estimated to be $108 million. The total implementation costs with a 15 percent contingency on construction material are estimated to be $121.4 million.

Table 14: Estimated total implementation costs for FTTP Model A (60% take-rate)

Cost element	Total cost
Total implementation costs	$108,000,000
Total implementation costs (with contingency)	$121,400,000

3.3.1.2 Model B design for all unserved and underserved locations

The total cost of the backbone and distribution plant for the design to reach all unserved and underserved locations—a total of 7,890 addresses—is approximately $142.5 million, or $18,060 per passing (with a 15 percent contingency). This cost is broken down below in Table 15. Again, note that the costs have been rounded.

Table 15: Estimated countywide backbone and distribution plant cost for all unserved and underserved locations

Fixed costs	
Project management	$900,000
Engineering and as-builts	$15,550,000
Conduit and vault infrastructure	$64,000,000
Materials	*$12,900,000*
Labor	*$51,100,000*
Aerial strand	$10,950,000
Materials	*$2,800,000*
Labor	*$8,150,000*
Utility pole make-ready	$4,350,00
Fiber optic cables and components	$27,750,000
Materials	*$18,300,000*
Labor	*$9,450,000*
Fiber splicing, testing, and documentation	$1,100,000
Hub facilities and systems	$500,000
Core network electronics	$1,200,000
Backbone and distribution plant total cost	**$126,200,000**
Post-Covid-19 market demand contingency on construction material (15%)	$16,300,000
Backbone and distribution plant total cost with contingency	**$142,500,000**
Number of passings	7,890
Cost per passing	**$18,060**

Table 16 presents the estimated costs for FTTP distribution electronics, subscriber drops, and CPE. As not all addresses will choose to sign up for service, we have estimated a take-rate of 60 percent—or 4,734 subscribers.

Table 16: Estimated distribution network electronics, subscriber drop, and CPE costs (FTTP Model B)

Cost element	**Cost**
FTTP distribution network electronics	$1,00,000
Subscriber drop costs (including MDU wiring)	$3,600,000
Customer premises equipment	$2,000,000
Total cost	$6,600,000
Total cost per subscriber	$1,400

presents the estimated total implementation costs for Model B, assuming a 60 percent take-rate. The total implementation costs are estimated to be $132.8 million. The total implementation costs with a 15 percent contingency on construction material are estimated to be $149.1 million.

Table 17 presents the estimated total implementation costs for Model B, assuming a 60 percent take-rate. The total implementation costs are estimated to be $132.8 million. The total implementation costs with a 15 percent contingency on construction material are estimated to be $149.1 million.

Table 17: Estimated total implementation costs for FTTP Model B

Cost element	Total cost
Total implementation costs	$132,800,000
Total implementation costs (with contingency)	$149,100,000

4. Funding opportunities

The high number of rural unserved addresses in Centre County make it a strong candidate for historic levels of federal funding, and the County has positioned itself well to leverage this moment. In anticipation of the wave of fiscal support, the County has developed a broadband strategic plan to explore funding opportunities, examine unserved and underserved areas, engage with anchor institutions, and establish relationships with incumbent and potential ISPs. These preliminary steps are foundational to optimizing broadband projects for grant awards and positioning the County favorably as it seeks to enter into public-private partnerships.

The newly established Pennsylvania Broadband Development Authority will help coordinate the expansion of high-speed internet across the state by managing the influx of federal funding available to support the deployment of broadband. Federal funding guidelines empower the Authority, led by a board of directors composed of representatives from the State's House and Senate, the Departments of Community and Economic Development, Education, Agriculture, and General Services; the Public Utility Commission; the Center for Rural Pennsylvania; and the State budget office,[26] to conduct extensive stakeholder outreach in preparation for establishing a statewide plan for broadband connectivity.

The uniqueness of this moment cannot be overstated. While the State is still in the process of determining the precise funding mechanisms and processes for issuing grants, the current and forthcoming funding opportunities represent the greatest investment in broadband to date.

4.1 The American Rescue Plan Act (ARPA)

The American Rescue Plan Act (ARPA) of 2021 established two potential funding sources for broadband projects: the Coronavirus State and Local Fiscal Recovery Funds (SLFRF) program and the Coronavirus Capital Projects Fund (CPF). The flexibility of these funds allows for creative solutions to a wide range of projects. Funds for both programs will be administered by the State and provide significant latitude if the fund administrators decide to use them for broadband.

Funding can be used for direct grants issued by the County or as a match for future federal funding opportunities. Targeting a smaller project in anticipation of additional funding from the Broadband Equity, Access, and Deployment (BEAD) program (discussed in Section 4.2.1) can advance the County's efforts to fill gaps in broadband service, remaining consistent with the goal of covering all unserved areas.

[26] "Pa. gearing up to take advantage of federal broadband funds." Farm and Dairy, January 5, 2022, https://www.farmanddairy.com/news/pa-gearing-up-to-take-advantage-of-federal-broadband-funds (accessed February 1, 2022).

4.1.1 Coronavirus Capital Projects Fund

The $10 billion CPF program—authorized under ARPA and administered by the U.S. Treasury—will provide flexible funding opportunities for a wide range of broadband-related projects to be administered at the state level.

Pennsylvania has received $278 million in CPF funds, which it will administer through the Pennsylvania Broadband Development Authority. The deadline for the Broadband Development Authority to submit a formal grant plan describing how the state's allocation will be used was September 24, 2022.[27]

The program will allow funds to be used for costs that fit into one of three major categories:

1. Broadband Infrastructure Projects: "[C]onstruction and deployment of broadband infrastructure designed to deliver service that reliably meets or exceeds symmetrical speeds of 100 Mbps so that communities have future-proof infrastructure to serve their long-term needs."

2. Digital Connectivity Technology Projects: "[P]urchase or installation of devices and equipment, such as laptops, tablets, desktop personal computers, and public Wi-Fi equipment, to facilitate broadband internet access for communities where affordability is a barrier to broadband adoption and use." You read that right: Affordability matters. Those who can't afford to pay for services, even if available, are considered unserved.

3. Multi-Purpose Community Facility Projects: "[C]onstruction or improvement of buildings designed to jointly and directly enable work, education, and health monitoring located in communities with critical need for the project."

4.1.2 Coronavirus State and Local Fiscal Recovery Funds

The U.S. Treasury released interim final rules for the SLFRF program in May 2022.[28] This ARPA program will distribute $350 billion in emergency funding to eligible state, local, territorial, and Tribal governments. Centre County was awarded $31,541,383.00 in State and Local Fiscal Recovery Funding.[29]

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[27] "Frequently Asked Questions," Capital Projects Fund. Dept. of the Treasury. Coronavirus Capital Projects Fund FAQs (treasury.gov) (accessed December 4, 2021).
[28] "Fact Sheet: The Coronavirus State and Local Fiscal Recovery Funds Will Deliver $350 Billion for State, Local, Territorial, and Tribal Governments to Respond to the COVID-19 Emergency and Bring Back Jobs," U.S. Department of the Treasury, May 10, 2021, https://home.treasury.gov/system/files/136/SLFRP-Fact-Sheet-FINAL1-508A.pdf (accessed September 27, 2021).
[29] "State County Allocation," U.S. Department of the Treasury, https://home.treasury.gov/system/files/136/fiscalrecoveryfunds_countyfunding_2021.05.10-1a-508A.pdf (accessed November 4, 2022).

Congress created this program with no limitations on how it could be spent on broadband. When Treasury announced its interim final rules, those guidelines included new restrictions that were not part of the authorizing legislation. The interim rules said the Fiscal Recovery Funds should not be targeted for areas where there is "reliable" 25/3 Mbps broadband service. Treasury has since clarified that these funds can be used in areas that already have 25/3 service if the funds are primarily targeted for areas where 25/3 speeds are not available.

Based on the legislation that created it, this program will fund broadband deployments and digital inclusion strategies designed to facilitate such connectivity and enables states and localities "to identify the specific locations within their communities to be served and to otherwise design the project" to fit their needs.[30] Treasury provided interim rules establishing certain minimum requirements on how recipients can use funds for broadband deployments;[31] it also provided guidance about the range of digital inclusion projects that can use program funds. Key guidance includes the following:

- **Infrastructure projects must support 100 Mbps symmetrical speeds unless geographical, topographical, or fiscal constraints make it impractical.** For the purposes of the Fiscal Recovery Funds, Treasury's approach to broadband infrastructure matches some of the most forward-thinking states' broadband grant programs. In its interim rules, Treasury expects the funds to be used on broadband deployments that are capable of at least 100/100 Mbps speeds to address Americans' modern communications needs. The program also strongly favors fiber deployments, because fiber is capable of affordably meeting the steady annual increase in broadband capacity demands faced by the nation's networks.

  The interim rules also outline a scenario in which symmetrical 100 Mbps service may be considered "impractical due to geographical, topographical, or financial constraints,"[32] and in that case, require projects to provide 100/20 Mbps service with the ability to scale to 100 Mbps symmetrical. This appears to be a concession to incumbent cable providers who can cost-effectively extend to unserved locations from their current network footprint and are on a roadmap to symmetric speeds. Most cable companies have implemented DOCSIS 3.1—and while they currently limit upstream speeds to 35 to 50

[30] "Coronavirus State and Local Fiscal Recovery Funds, Interim Final Rule," Department of the Treasury, 31 CFR Part 35, RIN 1505-AC77, released May 10, 2021, page 71, https://home.treasury.gov/system/files/136/FRF-Interim-Final-Rule.pdf. "Interim Final Rules," Interim Final Rules.
[31] "Coronavirus State and Local Fiscal Recovery Funds Frequently Asked Questions," pages 11-12, U.S. Department of the Treasury.
[32] Interim Final Rules, page 75, U.S. Department of the Treasury.

Mbps, field upgrades would allow them to deliver gigabit speeds upstream and would also put them on a long-term roadmap to DOCSIS 4.0's 10/6 Gbps capability.

- **Projects must prioritize areas that lack 25/3 Mbps.** The interim final rules state that projects will be expected to address unserved and underserved areas, with unserved areas defined as those that do not yet have access to speeds of at least 25/3 Mbps. This suggests wide latitude in designing projects—as long as they address unserved locations.

- **Projects are encouraged to prioritize affordability as well as local broadband solutions.** After noting that the U.S. has some of the most expensive broadband service in the world,[33] the program's interim rules emphasize the need for affordable broadband service. "Treasury also encourages recipients to prioritize support for broadband networks owned, operated by, or affiliated with local governments, non-profits, and co-operatives—providers with less pressure to turn profits and with a commitment to serving entire communities."[34]

- **Projects should prioritize last-mile connectivity.** While Treasury underscores this, states and localities are not precluded from setting their own priorities, and other initiatives that could improve affordability by investing in capacity bottlenecks such as middle-mile or data center builds could be funded.

- **Infrastructure projects are expected to meet strong labor standards.** This includes project labor agreements, community benefit agreements, and wages at or above the prevailing rate with local hire provisions. Treasury notes it will release additional guidance related to workforce reporting requirements at a later date, but expect fair (high) wage provisions, benefits, and local sourcing as key components.

- **Projects can address a wide array of broadband-related concerns.** In addition to infrastructure, SLFRF dollars can also be used for an array of other initiatives that respond to the public health and economic impacts of the pandemic. While Treasury leaves the door open for a wide variety of fundable initiatives, it offers the general guidance that recipients should "identify a need or negative impact of the Covid-19 public health emergency and, second, identify how the [proposed] program, service, or other intervention addresses the identified need or impact."[35]

[33] "Even in areas where broadband infrastructure exists, broadband access may be out of reach for millions of Americans because it is unaffordable, as the United States has some of the highest broadband prices in the Organization for Economic Co-operation and Development (OECD)." "Interim Final Rules," page 70, U.S. Department of the Treasury.
[34] "Interim Final Rules," pages 76-77, U.S. Department of the Treasury.
[35] "Interim Final Rules," page 10, U.S. Department of the Treasury.

- **Allocations from these funds can be leveraged as matches for other broadband grant opportunities.** Because these funds are considered locally administered, Fiscal Recovery Funds can be leveraged if an entity is already targeting a federal grant or state grant opportunity that requires matching funds**.**

4.2 Infrastructure Investment and Jobs Act (IIJA)

The $1 trillion Infrastructure Investment and Jobs Act (IIJA)—including $65 billion in broadband funding—was signed into law on November 15, 2021. Over the coming six months, the agencies responsible for administering the funds will release requests for comments; develop frameworks and rules; and issue notices of funding opportunities—including for the kinds of programs that could address gaps identified in Centre County.

The U.S. Department of Commerce's National Telecommunications and Information Administration (NTIA) will administer $48.2 billion of the broadband funding:[36]

1. *Broadband Equity, Access, and Deployment (BEAD) Program:* $42.45 billion "for broadband deployment, mapping, and adoption projects"
2. *Digital Equity Act Programs:* $2.75 billion "for grant programs that promote digital inclusion and equity to ensure that all individuals and communities have the skills, technology, and capacity needed to reap the full benefits of our digital economy"
3. *Tribal Broadband Connectivity Program:* $2 billion
4. *Enabling Middle Mile Broadband Infrastructure Program:* $1 billion "for the construction, improvement or acquisition of middle mile infrastructure" (Funding opportunity has been closed.)

Of these, BEAD and the Digital Equity Act programs represent opportunities for securing funding. BEAD funding will be made available through a competitive solicitation of grant proposals with what is supposed to be an extensive engagement with local communities. If the grant program allows for counties and other local government units to partner with ISPs and the process gives preference for locally supported partners, the County could have significant influence on who gets funded for what areas with which services. The Digital Equity Act programs are also expected to result in a state-administered competitive grant program. Depending on how it gets structured, the County could apply itself, support local non-profit organizations' applications, or otherwise facilitate successful grant applications. In addition to these programs, the IIJA allocates an additional $14 billion to the Affordable Connectivity Program—a subsidy that likely will go directly to low-income broadband subscribers.

[36] "Grants," NTIA, https://ntia.gov/category/grants (accessed November 17, 2021).

4.2.1 Broadband Equity, Access, and Deployment (BEAD) program

Pennsylvania will receive a minimum of $100 million in funding from the Broadband Equity, Access, and Deployment (BEAD) program, representing the initial minimum distribution to each state.[37] Additional allocations will be distributed based on a state's unserved and high-cost areas—which could result in up to $1.2 billion for Pennsylvania.[38]

NTIA reports that "the first priority for funding is for providing broadband to unserved areas (those below 25/3 Mbps), followed by underserved areas (those below 100/20 Mbps), and then serving community anchor institutions (1/1 Gbps)."[39] A subgrantee that receives funding to deploy a network will be required to ensure the network is capable of delivering at least 100/20 Mbps service within four years of the date of the subgrant—and to offer a low-cost service for low-income subscribers.[40] BEAD funding requires a 25 percent match but is flexible as to the source of match so long as it is not derived from federal funding. In preparation for this opportunity, the County should begin setting aside funding now and continue to develop strong private partnerships to share the fiscal burden.

However, the law also indicates that BEAD grants can also be applied broadly to address broadband needs, including for broadband planning (up to 5 percent of funding), connecting anchor institutions, supporting broadband adoption efforts, and constructing infrastructure to serve low-income families in multi-dwelling buildings.[41]

Timing of this funding is highly dependent on the FCC's completion of the new broadband mapping—the first iteration of which is expected in early November—that will determine how the overall allocations will be calculated for each eligible entity. Expect the rules to be issued within six months (the NTIA has 180 days from the signing of the bill to issue the rules), without details on timing if the FCC has not yet completed its efforts.

4.2.2 Digital Equity Act programs

NTIA's digital equity program, which was established in the Digital Equity Act as part of the IIJA, comprises three elements:

1. State Digital Equity Planning Grant Program ($60 million)

[37] "The Broadband Equity, Access & Deployment Program (BEAD): $42.45 Billion for State Broadband Grants," National Law Review, $45.45 Billion for State Broadband Grants (natlawreview.com) (accessed December 6, 2021).
[38] "A Guide to Federal Broadband Funding Programs - Overview of BEAD, Dec. 2021," NYU Law School, https://digitalcommons.nyls.edu/cgi/viewcontent.cgi?article=1000&context=reports_resources (accessed August 1, 2022). Brandon Carson, the executive director of the Pennsylvania Broadband Development Authority, estimates the amount to be as high as $1.2 billion. See https://www.governing.com/community/pennsylvania-could-get-1-2b-for-broadband-if-it-meets-deadline
[39] "Grants," NTIA, https://ntia.gov/category/grants (accessed November 17, 2021).
[40] IIJA, p. 771, https://www.congress.gov/bill/117th-congress/house-bill/3684 (accessed November 17, 2021).
[41] IIJA, p. 767, https://www.congress.gov/bill/117th-congress/house-bill/3684 (accessed November 17, 2021).

2. State Digital Equity Capacity Grant Program ($1.44 billion)
3. Digital Equity Competitive Grant Program ($1.25 billion)

NTIA has stated that these programs aim "to promote the meaningful adoption and use of broadband services across the targeted populations in the Act, including low-income households, aging populations, incarcerated individuals, veterans, individuals with disabilities, individuals with a language barrier, racial and ethnic minorities, and rural inhabitants."[42]

The State Digital Equity Planning Grant Program provides funding directed to state broadband offices to develop digital equity plans, with required local stakeholder engagement and input. These plans serve as the framework for each state's digital equity projects that can be funded through the State Digital Equity Capacity Grant Program and the Competitive Digital Equity Capacity Program.

NTIA requires states to include their "vision" for digital equity in their statewide plans, as well as identify barriers to digital equity, and outline measurable objectives and methods for addressing those barriers. These methods could include digital literacy programs, public computing and broadband access programs, workforce development, and affordability and subsidy programs. These plans must also coordinate with and incorporate the BEAD planning process.[43]

4.2.3 Appalachian Regional Initiative for Stronger Economies (ARISE) grant program

Utilizing $73.5 million in funding from the IIJA, the Appalachian Regional Commission (ARC) has launched a new grant initiative focused on economic and workforce development intended to "drive large-scale, regional economic transformation through multi-state collaborative projects across Appalachia." Community infrastructure is one of the core investment priorities of the Appalachian Regional Initiative for Stronger Economies (ARISE)[44] program, acknowledging that "access to reliable and affordable utilities and infrastructure ensure that Appalachia's residents can successfully live and work in the Region."

4.2.4 Affordable Connectivity Program

The $14.2 billion Affordable Connectivity Program (ACP) is a federal broadband program administered by the FCC. The ACP provides a $30 monthly subsidy that may be used toward a broadband subscription with an ACP-participating provider. The program is available to

[42] "Grants," NTIA, https://ntia.gov/category/grants (accessed November 17, 2021).
[43] NTIA Notice of Funding Opportunity, State Digital Equity Planning Grant Program, Section IV.C, May 13, 2022 (Digital Equity Planning), https://broadbandusa.ntia.gov/resources/grant-programs/digital-equity-programs (accessed June 5, 2022).
[44] "ARC Launches $73.5 Million Grant Initiative in FY22 to Spur Multistate Collaboration to Transform Appalachia's Economy Through President Biden's Bipartisan Infrastructure Law," Appalachian Regional Commission, https://www.arc.gov/news/arc-launches-73-5-million-grant-initiative-in-fy22-to-spur-multistate-collaboration-to-transform-appalachias-economy/ (accessed September 7, 2022).

households with an income at or below 200 percent of established Federal Poverty Guidelines,[45] or if a member of the household meets at least one of the other eligibility criteria outlined by the FCC.[46] Decision makers may choose to leverage this program with potential partners to further the County's digital equity efforts. For example, to address the affordability barrier to connectivity, the County might consider a programmatic effort to promote the ACP to help residents pay for internet subscriptions.

[45] "Do I Qualify," Universal Service Administrative Company, https://www.affordableconnectivity.gov/do-i-qualify/ (accessed October 3, 2022).
[46] Affordable Connectivity Plan, https://www.fcc.gov/acp (accessed October 3, 2022).

5. An RFP could be the next step in identifying projects to address unserved locations and prepare for incoming funding

Administering a request for proposal (RFP) for countywide, futureproof broadband deployment could be the most efficient way to identify competitive partners to address unserved locations. Allocating County funds to initiate an RFP process would serve two purposes: first, to adopt projects for quick deployment with funding that the County has been able to allocate in the near term, and second, to identify potential projects for a county-wide approach in anticipation of IIJA funding that favors rural expansion and deployment.

Considering the large and closely positioned areas that could make broadband expansion attractive for a variety of potential partners—all of which might have competitive proposals—a formal RFP process will allow the County to leverage its infrastructure (pole attachments, for example) to reduce its share of matching funds for any future grant partnerships. It is possible that one or more providers could propose to absorb a higher proportion of capital costs to secure those areas and prevent competitors from moving into the unserved areas. Because many unserved areas are relatively close to underserved areas and/or potential bidders' current service areas, such a process could also effectively maximize the prospects of upgrades to existing infrastructure and targeting all unserved areas.

A multi-award RFP framework can also target other policy-based preferences for the County and be structured to evaluate bids based on:

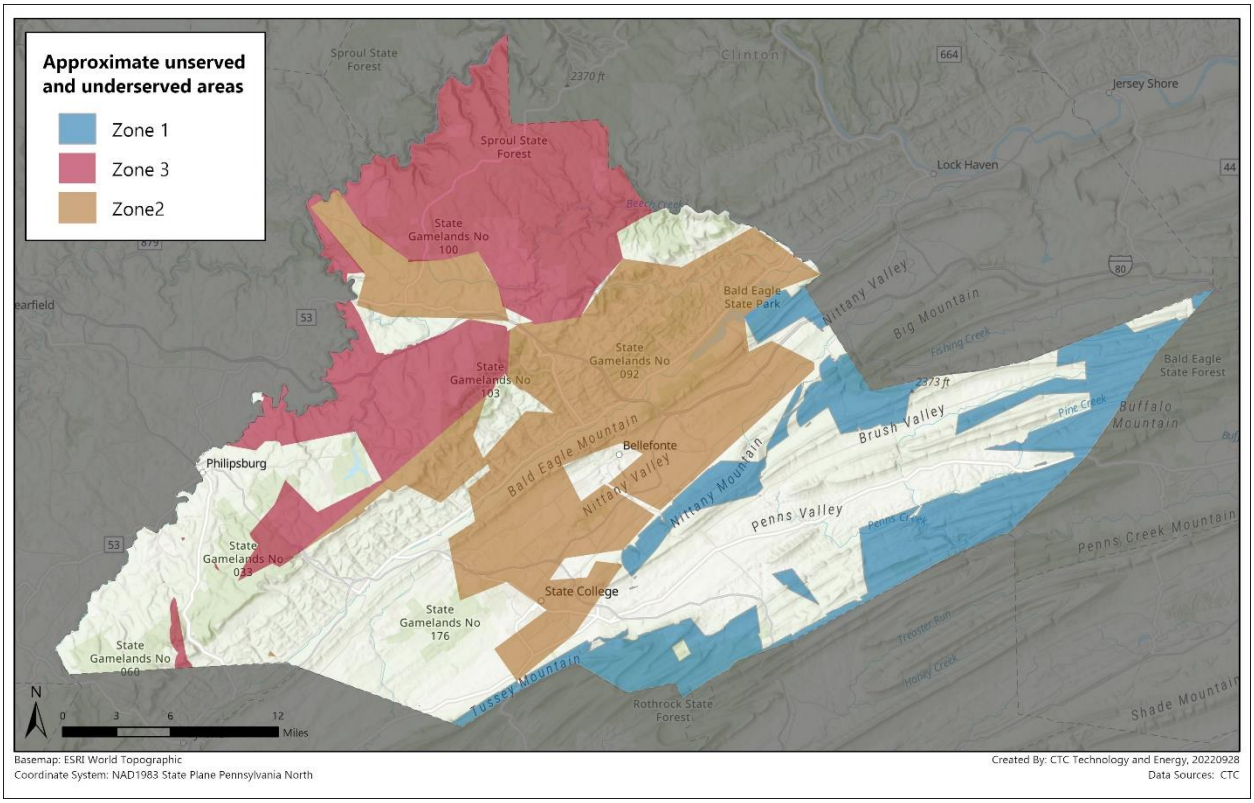
- Fiscal soundness and experience of the proposer
- Per passing costs (and the allocation of those costs among the respondent, the County, and an external grant funder)
- Proposed network technology and speed
- Speed of deployment of the infrastructure
- Low-cost subscription plan availability and participation in the ACP, a which subsidizes subscription costs for eligible low-income households
- Willingness to participate in awareness campaigns to encourage participation in subsidy programs like the ACP

Formalizing the RFP process will allow the County to quickly take advantage of upcoming grant opportunities by having already selected partners who could help alleviate the burden of matching funds.

The County can structure a multi-award RFP, encouraging respondents to target all areas or only the ones that are most viable. With a whole-county solution in mind, CTC recommends a multi-phased approach to serving Centre County's communication needs:

- Zone 1: Unserved areas in the east that could be relatively easier to connect in advance of BEAD funding due to the higher density of unserved locations
- Zone 2: Areas in the center of the County where incumbents can leverage nearby infrastructure
- Zone 3: Remote locations with low population density and rough terrain characterize this area making these rural unserved locations the most costly to address. It is recommended that the County wait for BEAD funding to target this area.

Figure 21: Proposed zones to prioritize broadband projects



5.1 Zone 1: Prioritize eastern unserved areas in the near term using County funds

By undertaking an RFP process, the County can identify projects for fast deployment to unserved addresses while considering projects with the potential for future IIJA funding. While a whole-county approach is recommended, it is possible to prioritize areas where existing infrastructure

will facilitate filling gaps before BEAD funding becomes available. This approach will provide County leadership with a quick win in demonstrating its connectivity efforts and help to further identify and define gaps in suburban areas with existing and accessible wireline infrastructure. The first such area, or Zone 1, is the County's eastern-most peninsula, which is comprised of moderately high density and proximity to available high-quality wireline infrastructure.

5.2 Zone 2: Target unserved and underserved areas with nearby incumbents

Addresses in the central swath of the County stretching north to south—Zone 2—will also be relatively cost-effective to reach based on ISPs' proximity to existing infrastructure. Broadband deployments costs are typically lower for edge-out and fill-in approaches by incumbent providers than for deployment in areas farther away from existing network assets. Some existing providers may offer highly competitive per passing costs by constructing line extensions to areas close to their existing or planned infrastructures, or by expanding the boundaries of their existing network coverage outward from their current edges (i.e., an edge-out strategy).[47] The County should consider including provisions to ensure that providers deliver high speed, reliable service to their entire footprint, as opposed to selectively choosing areas based on potential revenue projections. Establishing these guidelines will prevent ISPs from cherry-picking select markets and risking abandoning outlying unserved areas due to the now higher cost of reaching these locations.

5.2.1 Require upgrades to cable infrastructure

The County has received substantial consumer feedback on the speeds and reliability of internet delivered by coaxial cable provider Zito Media, which has a large footprint in Zone 2. A rapidly growing network of aging hardware, outdated software, and thinning infrastructure have reduced the provider's ability to sustain the promised quality of service. Considering the large County footprint served by Zito Media, CTC recommends working with the provider to upgrade its network to improve speeds and connection reliability with an eye toward future expansion.

5.3 Zone 3: Reaching the County's most rural residents will be costly and require creative partnerships

While the County is committed to futureproof, fiber technology to serve all residents, Zone 3's low population density, rough terrain, and remote locations will prove challenging in meeting this goal. The County and private partners will need to think creatively to make the most effective use of public funds. Zone 3 will require infrastructure upgrades to facilitate robust, reliable internet for even the most remote residents.

[47] A new broadband provider would likely be less competitive in offering cost-effective solutions to serving these isolated areas because it would not have existing plant adjacent to the isolated roads.

5.4 Costs to address unserved and underserved locations by zone

Approximate costs for addressing unserved and both unserved and underserved locations in the three aforementioned priority zones are outlined in Table 18 and Table 19.

Table 18: Costs for construction to address unserved locations by zone

	Zone 1	Zone 2	Zone 3
Backbone and distribution plant	$38,380,000	$38,300,000	$40,470,000
Number of passings	1,970	1,050	1,260
Cost per passing	***$19,482***	***$36,400***	***$32,100***
Distribution network electronics, subscriber drops, and CPE (60 percent take-rate)	$1,955,000	$1,042,000	$1,250,000
Number of subscribers (60 percent take-rate)	1,182	630	756
Cost per subscriber	***$1,650***	***$1,650***	***$1,650***
Total implementation cost including contingency	**$40,335,000**	**$39,342,000**	**$41,720,000**

Table 19: Costs for construction to address both unserved and underserved locations by zone

	Zone 1	Zone 2	Zone 3
Backbone and distribution plant	$44,700,000	$61,400,000	$36,400,000
Number of passings	2,111	4,512	1,267
Cost per passing	***$21,200***	***$13,600***	***$28,700***
Distribution network electronics, subscriber drops, and CPE (60 percent take-rate)	$1,800,000	$3,700,000	$1,100,000
Number of subscribers (60 percent take-rate)	1,267	2,707	760
Cost per subscriber	***$1,400***	***$1,400***	***$1,400***
Total implementation cost (with 15 percent contingency)	**$46,500,000**	**$65,100,000**	**$37,500,000**

5.5 Include an ongoing performance testing process and subscriber data reporting as a condition of partnerships for last-mile service provision

Grant partnerships can be highly attractive for potential partners and can therefore provide leverage for the County to negotiate additional terms. One common frustration experienced by local, state, and County governments is the lack of performance data from ISPs serving residents in their jurisdictions. Speed tests and subscriber reports are not systematic enough, and ISPs rarely allow joint testing with standardized methodologies without contractually based requirements. This lack of data makes it more difficult for the County to track whether ISPs are delivering on promised speeds reliably, complying with any relevant grant-based performance commitments, or leaving gaps in their claimed service areas that could be targeted for upgrades or future broadband expansion. One of the conditions for entering a grant partnership with the County should be to accept ongoing performance testing.

Likewise, data from such partners connected locations, activations, and customers participating in low-cost or subsidy programs can help the County develop future infrastructure expansion projects and initiatives to encourage adoption of high-speed broadband connectivity for low-income households. This information will also be critical for future applications for IIJA-related funding, which requires digital equity considerations for eligible projects.

Appendix A: Methodology and data sources

The analyses in this report are built on publicly available data, including the FCC's Form 477 data and the U.S. Census Bureau's American Community Survey.

This assessment recognizes that Form 477 data, which are self-reported by ISPs, represent a best-case scenario because 1) the data are presented at the census block level, and 2) the FCC considers a census block served by broadband if just one of the premises in the block could be served. The data thus tend to overestimate service availability, especially in less populated areas where census blocks are larger and in areas with a high density of multi-dwelling units, which may lack internal wiring sufficient to deliver broadband speeds to all units or may have exclusivity agreements with ISPs that are not reflected in the data.

FCC service data are also inconsistent for non-populated areas such as parks or wildlife reserves. For example, if an ISP has extended service to a single visitors' center or building, FCC data may show a large unserved area around that location as being served. In addition, a provider that reports it offers service on Form 477 may not offer residential broadband services in the market at all.

While the data are thus flawed, Form 477 represents the most comprehensive national data set for broadband availability and presents value for understanding broadband investment and availability patterns.

The drawbacks inherent in Form 477 data are also expected to be ameliorated when the FCC releases updated broadband maps at the address level, which is likely to happen late in 2022 or early in 2023. The analysis presented in this report should be refreshed at that time in light of the FCC's new data.